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DEPARTMENT OF INTERNAL AFFAIRS

GROUND WATER RESOURCES OF BUCKS COUNTY, PENNSYLVANIA

By

DAVID W. GREENMAN

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By
DAVID W. GREENMAN
U. S. GEOLOGICAL SURVEY

Prepared by
The United States Geological Survey
Ground Water Branch
in cooperation with
The Pennsylvania Geological Survey

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GROUND WATER RESOURCES

OF

BUCKS COUNTY, PENNSYLVANIA

By David W. Greenman[1]

ABSTRACT

Bucks County is in southeastern Pennsylvania. It is both an agricultural and industrial area, but the principal feature in its current economic growth is the tremendous industrial expansion in the southeastern part of the county.

Gound-water supplies in Bucks County are obtained from consolidated-rock aquifers ranging in age from Precambrian to Triassic, which underlie the uplands, and from unconsolidated-rock aquifers of Cretaceous and Quaternary age which underlie the lowlands along the Delaware River below Morrisville. About half the daily withdrawal of 25 million gallons in 1953 was obtained from unconsolidated-rock aquifers, which are the best potential sources of additional supplies in the county and could yield several hundred million gallons per day with proper development.

Supplies available from Triassic rocks, especially the Stockton lithofacies, far exceed the present rate of withdrawal, in spite of the rather low permeability of the rocks. As these rocks underlie more than four-fifths of the land area of the county, their potential value as a source of supply is very great, but development must be carefully planned to avoid local overdevelopment.

There is no locality in the county in which critical declines of ground-level have occurred, although there are numerous places where little or no ground water can be obtained. The latter areas are underlain by igneous or metamorphic rocks whose total land area comprises less than 5 percent of the county.

The chemical quality of ground water in Bucks County is universally good. None of the waters sampled contained concentrations of dissolved salts that make them unfit for domestic or agricultural use, and most are suitable for many industrial uses without treatment.

Interpretations and conclusions presented in this report are based upon records of construction and yield for 652 wells (some of which tap each of the geologic formations that underlie the county), on water-level records for 12 observation wells, and on chemical analyses of water from 73 wells.

INTRODUCTION

Purpose and Scope of Investigation

This investigation was made in cooperation with the Pennsylvania Department of Internal Affairs, Bureau of Topographic and Geologic Survey, and is part of a Statewide program of investigation of the underground water resources. The general purpose of these studies is to collect data on the hydrologic and geologic factors that relate to the occurrence, movement, availability, and chemical quality of ground water in Pennsylvania, to evaluate and interpret these data, and to make the results of the investigations available to the public.

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[1] Geologist, U. S. Geological Survey, Ground Water Branch.

Ground-water studies in Pennsylvania are designed to provide detailed, comprehensive information on the hydrology of selected geologic formations or systems. The purpose of this report is to summarize the available data for Bucks County, pending the completion of detailed studies of the aquifers. Subsequent comprehensive reports will describe the hydrology of the Triassic rocks, and of the unconsolidated deposits of Pennsylvania, which together underlie about 90 percent of the total land area of Bucks County.

This investigation was made under the general direction of A. N. Sayre, chief of the Ground Water Branch of the United States Geological Survey; and under the immediate supervision of Paul H. Jones, district geologist in charge of cooperative ground-water studies in Pennsylvania.

Location and General Features of the Area

Bucks County is in southeastern Pennsylvania. The county has a land area of 617 square miles and occupies a roughly rectangular area 40 miles long from northwest to southeast and 15 miles wide from northeast to southwest. The county is bounded on the northeast and southeast by the Delaware River, which marks the border between Pennsylvania and New Jersey; on the southwest by Philadelphia and Montgomery Counties; and on the northwest by Lehigh and Northampton Counties. Bucks County is wholly within the Delaware River basin and is one of the 11 counties of Delaware, New Jersey, and Pennsylvania that are collectively known as the Philadelphia Tri-State District.

For more than 200 years after it was founded in 1682, Bucks County was primarily an agricultural area. The relatively flat lying land, rich soil, evenly distributed rainfall, and long growing season of the area

Figure 1. Map of southeastern Pennsylvania showing location of Bucks County.

favored the expansion of agriculture. From the middle of the 19th century until the start of the second World War, however, there was a gradual but continuous growth of industry in the county. This trend was greatly accelerated after the war by the construction of the Fairless Works of the United States Steel Co. at Morrisville. Bucks County, and especially the southeastern part, is well situated to meet the needs of heavy industry. Plentiful supplies of surface water and ground water of excellent quality are available. The area is located close to the major domestic markets and maritime ports along the eastern seaboard and it is conveniently located with respect to water, rail, and highway transportation. The Delaware River is navigable from Morrisville to the sea, and main lines of the Pennsylvania and Reading railroads link the southern part of the county with Philadelphia and New York. The Pennsylvania Turnpike crosses southeastern Bucks County, and a network of more than 800 miles of paved highways join the county with other important commercial centers. These advantageous factors have all served to promote the influx of industry to the area, and at the present time the value of manufactured products exceeds by many times the value of farm products in the county. Agriculture remains an important enterprise, however, particularly in the central and northern parts of the county.

The population has grown simultaneously with the expansion of industry in the county. The population increased from 82,476 in 1920 to 144,620 in 1950, the largest part of the gain occurring in the industrial area in the southeastern part of the county.

Physiography

Bucks County comprises parts of four physiographic provinces (Lobeck, 1932) which cross it in belts trending roughly northeast-southwest. The southeasternmost belt is the Coastal Plain, which is bounded on the northwest by the Fall Line and is underlain by rocks of Cretaceous and Quaternary age, only the latter appearing at the land surface. (See pl. 1.) The Fall Line, as the name implies, is a line of contact between the unconsolidated rocks of the Coastal Plain and the consolidated rocks that bound its inner edge, marked by falls or rapids in streams that cross it in their course seaward. The altitude of the land surface in the Coastal Plain province in Bucks County ranges from sea level to about 60 feet above sea level.

Inland from and adjacent to the Coastal Plain lies a submaturely dissected peneplain termed the Piedmont Upland. It is roughly triangular in shape, with the apex at Morrisville and the base on the Bucks-Philadelphia County line. The Piedmont Upland is underlain by ancient crystalline rocks of Cambrian or Precambrian age (pl. 1), and is bounded on the northwest by their line of contact with sedimentary rocks of Triassic age. The local relief in the Piedmont is about 100 feet and the altitude ranges from about 40 to about 260 feet above sea level.

By far the largest part of Bucks County lies within the Triassic Lowland physiographic province, which occupies most of the central and northern parts of the county, except for a small area in the extreme northernmost corner, in the vicinity of Durham. The Triassic Lowland is a slightly

uplifted peneplain formed upon easily eroded inclined strata, with residual ridges marking the location of tilted layers of volcanic rocks. The general level of the peneplain lies between altitudes of about 100 feet and 600 feet above sea level, tops of some ridges rising above 800 feet. Local relief is rarely greater than 250 feet.

The northernmost corner of Bucks County is a part of the Reading Prong of the New England Upland physiographic province. It is a deeply dissected and glaciated peneplain formed on folded and faulted Cambrian limestone and quartzite and Precambrian gneiss. The local relief is as great as 500 feet, the tops of ridges rising 800 feet or more above sea level.

Climate

Bucks County is in the eastern coastal climatic belt and has a typical maritime climate. It is very moderate in its extremes. For only about one day in the average year is the temperature below 0°F, and the temperature in the summer rarely rises above 100°F. The area has relatively high humidity, owing to its proximity to the ocean. Precipatation is evenly distributed throughout the year and snow is uncommon before December and after mid-April.

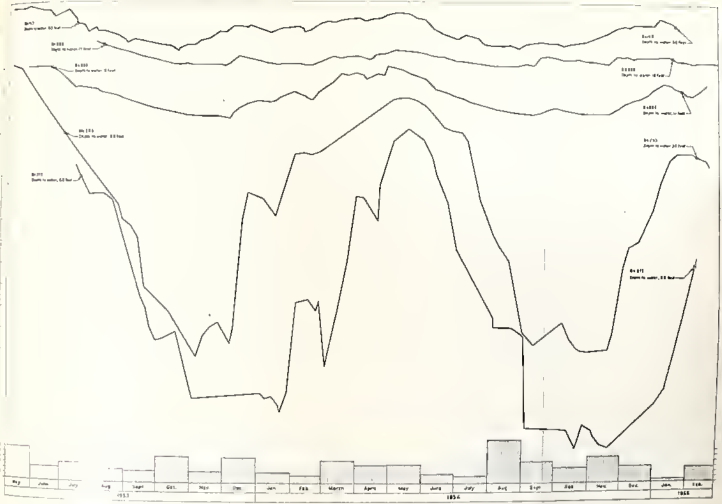
The United States Weather Bureau maintains precipitation and temperature stations at George School and Quakertown. Data for the stations are given in table 1, and the average of precipitation at the two stations is graphed on plate 2.

Table 1.—Precipitation and temperature at George School and Quakertown

Month	Precipitation (1907-54) (inches)						Average air temperature (1909-54) (°F)	
	Maximum		Minimum		Average			
	George School	Quaker-town	George School	Quaker-town	George School	Quaker-town	George School	Quaker-town
January	7.74	6.68	1.34	0.63	3.43	3.59	31.5	27.6
February	5.85	4.64	1.26	1.34	2.76	3.29	31.8	29.3
March	8.58	6.00	0.57	1.23	3.61	3.65	40.5	43.4
April	6.65	8.25	1.23	0.94	3.61	3.51	50.4	48.7
May	8.49	10.64	1.17	1.66	3.90	4.21	61.1	61.9
June	9.93	12.01	0.21	0.76	3.62	3.85	69.5	68.4
July	16.11	11.81	0.59	0.86	4.70	4.94	74.2	72.8
August	11.84	10.51	1.05	1.09	4.60	4.43	72.3	70.3
September	8.72	9.93	0.35	0.35	3.52	3.67	66.2	64.0
October	7.87	7.71	0.29	0.82	3.09	3.30	55.4	52.5
November	8.62	7.94	0.35	0.51	3.23	3.42	43.9	41.6
December	7.17	5.79	1.06	1.44	3.36	3.46	33.6	32.8

Acknowledgments

This investigation was begun in 1945 by R. R. Huber, who collected data on some 100 municipal and industrial wells. During 1949 J. C. Kammerer compiled geologic and hydrologic data on southeastern Bucks County for a brief water-resources report on the area by Graham,



HYDROGRAPHS OF PRECIPITATION AND WATER LEVELS IN SELECTED WELLS IN BUCKS COUNTY, PENNSYLVANIA

PLATE 2

Mangan, and White (1951). The field studies for this report were completed in 1953 by J. C. Kammerer, W. A. Mourant, and N. H. Klein, who made the well inventory and collected water samples for chemical analysis. The analyses were made in the laboratory of the Geological Survey at Philadelphia. Pa.

Much of the information on the geologic units is from a manuscript report on the geology of Bucks County by Bradford Willard, D. B. McLaughlin, E. H. Watson, and others. That report is to be published, when completed, and is now on file with the Director of the Pennsylvania Topographic and Geologic Survey at Harrisburg. The geologic map to accompany that report has been published. It is used as plate 1 in this report.

PRINCIPLES OF GROUND-WATER HYDROLOGY

Occurrence and Movement

Essentially all the rocks that form the crust of the earth have openings which contain and transmit water. The nature and distribution of the rock openings is determined by the character of the rocks, and by their geological experience. Unconsolidated rocks and weakly cemented granular rocks contain primary openings—that is, interstitial voids that are products of the original conditions of deposition. Consolidated rocks, including cemented sandstone, shale, limestone, and crystalline rocks, contain cavities comprising joints, openings along planes of bedding and schistosity, faults, etc., which commonly have been enlarged by solution. These openings are termed secondary because they are not inherent to the rock but occur as a result of crustal movements, solution, or the action of destructive weathering processes that modified the rock after it was deposited.

The flow of springs and the water obtained from wells is ground water. Ground water is defined as that part of the water beneath the surface of the earth that occurs in the zone of saturation. In the zone of saturation all the connected pores, crevices, and voids in the rock are filled with water under hydrostatic pressure. The number, size, and shape of the rock openings, and the degree of interconnection between them, determine the effectiveness of any saturated rock unit as a source of water. A body of rock that yields sufficient water to make it an economic source of supply is called an aquifer.

As a part of the earth's natural drainage system, ground water moves under the influence of gravity from intake areas toward lower levels, and ultimately to points of discharge. The direction and rate of movement are controlled by the "hydraulic gradient," which is defined as the difference in head between two points divided by the flow distance between them. Unlike flow on the land surface, where water moves freely in open channels, ground-water flow is through openings in the rocks. Because most of these openings are small, they offer considerable resistance to the flow of water. Consequently, the natural rate of ground-water movement is slight compared to that of surface water, and is commonly measured in terms of feet or fractions of a foot per day, or-even per year.

Precipitation is the source of essentially all ground water. Ground water may be derived either from local precipitation or (more commonly in arid regions than in Pennsylvania) from streams whose channels are cut into water-bearing beds. In general, ground-water supplies in the consolidated rocks of the Piedmont are replenished entirely by precipitation which falls within the outcrop area of the individual formations. Under natural conditions, local precipitation probably would be the principal source of recharge to the unconsolidated deposits also, but, since the time wells of large yield first tapped the valley-fill and Coastal Plain sediments in southeastern Bucks County, a part of the recharge has been furnished by infiltration of water from the Delaware River.

Ground water is obtained for use through wells and springs. Springs are natural ground-water outlets. They were in extensive use as a source of supply in the early days, but have been largely replaced by wells since the development of modern drilling and pumping methods.

Wells intercept ground water as it moves through the rocks toward points of natural discharge or induce infiltration of water from a surface source, such as a lake or stream. The long-term yield of a well is determined by the hydraulic characteristics of the aquifer—the ability of the aquifer to store and transmit water, the rate of replenishment of water to the aquifer, and the construction of the well. The hydraulic characteristics of an aquifer are expressed as its coefficients of storage and transmissibility. The coefficient of storage is defined as the volume of water released or taken into storage by the aquifer per unit surface area of the aquifer per unit change in the component of head normal to that surface. The storage coefficient controls the rate at which the cone of influence about a pumped well will expand into other parts of the aquifer. If a well that taps a homogeneous aquifer is pumped, the rate of expansion of the cone of depression—or the rate of transmission of the effect of withdrawal—varies inversely with the storage coefficient of the aquifer, and is independent of the quantity of water that is pumped from the well.

The coefficient of transmissibility is defined as the field coefficient of permeability times the thickness of the aquifer in feet. The field coefficient of permeability is defined as the rate of flow, in gallons per day, through a unit cross-sectional area of the aquifer under a unit hydraulic gradient at the prevailing temperature of the water. The coefficient of transmissibility is a principal factor determining the amount of drawdown in a pumped well because it controls the slope of the cone of depression.

The transmissibility of an aquifer is closely related to the specific capacity of wells that tap it. Specific capacity is defined as the yield of a well per unit decline of water level, and is commonly expressed as gallons per minute per foot of drawdown. The specific capacity of a well generally varies directly with the transmissibility of the aquifer through the range of discharge rates at which water entering the well obeys the laws of laminar flow, under which head loss is proportional to velocity. However, at higher discharge rates the velocity of entry exceeds the critical velocity for the aquifer, and at least a part of the

water enters the well under conditions of turbulent flow, for which head loss varies as the square of the velocity.

Ground water may occur under either water-table or artesian conditions. Under water-table conditions the ground water is not confined and the water level in a well marks the upper surface of the zone of saturation, called the water table. Under artesian conditions there is no water table, as the ground water is confined under hydrostatic pressure between two relatively impermeable bodies of rock, and the water level in a tightly cased well is above the upper limit of the artesian aquifer. The imaginary surface defined by the levels to which the water will rise in artesian wells is called the piezometric surface.

True artesian conditions exist in nature on only a minute scale, because no rock is completely impervious over a large area. A confining bed need only be less permeable than the underlying strata to produce artesian head in those strata. Thus a rock formation may be sufficiently permeable to be an aquifer, but if it is less permeable than the underlying rock it may also act as a confining bed. If there is no sharp contrast in the permeabilities of the respective beds, or if the confining bed is discontinuous, the confined water may be said to occur under semiartesian conditions. Such conditions prevail for most occurrences of confined ground water in Bucks County.

There are significant differences in the behavior of ground water in water-table and artesian aquifers. Water-table aquifers function as natural reservoirs of ground water from which withdrawals can be made between periods of replenishment; water-table conditions occur in the catchment areas of aquifers where the rock is exposed to recharge directly from above. Widespread circulation of ground water does not occur in water-table aquifers even though they underlie most of the land area in a humid region such as eastern Pennsylvania. Because of the local origin of recharge, the water table is always a subdued replica of the surface topography; therefore the direction and slope of the natural hydraulic gradient in any locality is related to the local topography. The ground water drains from the uplands towards the valleys and is discharged through springs or seeps along the valley walls and in stream beds. Furthermore, the physical nature of water-table aquifers does not favor extensive movement.

The storage coefficient of water-table aquifers may range from 0.01 to 0.40 (and commonly is greater than 0.10). Withdrawal of water from a water-table aquifer is supplied from aquifer storage by draining the pore spaces of the saturated rock in the vicinity of the locus of withdrawal. The resulting decline in water level around the point of discharge occurs in the form of an inverted cone which expands until it intercepts sufficient recharge to balance the withdrawal without further dewatering of the aquifer. Because of the large storage capacity of water-table aquifers, the cone of influence expands slowly; and, because recharge is locally derived from downward-percolating waters, the area of influence does not extend any great distance from the point of discharge. Consequently, fluctuation of water level in one area will not appreciably influence water levels in other areas, and excessive local withdrawals during droughts may cause critical declines of water level in water-table aquifers even though nearby areas are not affected by the pumping.

An artesian aquifer functions largely as a natural conduit that is recharged from the part of the aquifer that is under water-table conditions at the outcrop, and that transmits ground water under hydrostatic pressure to points of escape where the confining bed is absent or broken, or where water is withdrawn through wells. Artesian aquifers favor long-distance circulation of ground water. Their occurrence may be independent of the surface topography; points of recharge and discharge may be far from one another, and movement of the water is the result of unbalanced hydrostatic pressure on the confined water. As under water-table conditions, the ground water moves in the direction of the hydraulic gradient, but the hydraulic gradient in an artesian aquifer is commonly more persistent over wide areas than that in a water-table aquifer because it is not influenced by local topographic features.

The storage coefficient of artesian aquifers is commonly less than 0.001. Under artesian conditions this value is related to the elasticity of the aquifer and the contained water, not to the drainable pore space as under water-table conditions. Artesian aquifers may have as large a porosity as water-table aquifers, but the yield of an artesian well is not supplied by dewatering the aquifer—rather it is derived from compaction of the aquifer skeleton and expansion of the water as the hydrostatic pressure is decreased in response to the withdrawal of water. When an artesian well discharges, the resulting decline of pressure head is transmitted rapidly through the aquifer to outcrop areas or boundaries where the rates of discharge and recharge adjust to balance the withdrawal. Thus, fluctuations of water level at a given point in an artesian system may be reflected in a change in conditions of recharge or discharge at a considerable distance. By the same reasoning, local droughts have little effect on artesian water levels in the locality because artesian aquifers commonly have remote sources of recharge.

Quality of Ground Water

Chemical Quality

The chemical and physical characteristics of ground water are important factors to consider in any description of the hydrology of an aquifer. The quality of ground water is intimately related to its source of recharge and to its geologic habitat; and in many instances it is the factor that determines the usability of the aquifer as a source of supply.

All natural ground waters contain dissolved mineral matter, the result of leaching of soluble material from the soil and rock with which the water has been in contact. The types and concentrations of the minerals in solution are primarily functions of the types of rock through which the water has moved, the length of time of the contact, and the physical conditions of the contact—that is, the temperature and pressure. Consequently, the natural chemical character of ground water commonly bears a distinct relation to that of the aquifer in which it occurs.

Human activities may cause significant changes in the chemical quality of ground water. Mineral and organic impurities are introduced directly into aquifers through wells used for disposal of sewage and industrial wastes. Even more widespread and appreciable changes in the chemical

quality of ground water occur in some areas as the indirect result of large withdrawals of water from an aquifer. A given aquifer may be hydraulically continuous with another aquifer or with a surface supply containing water of a different chemical character. Under natural hydraulic gradients the movement of water may be from the given aquifer toward the other reservoirs. However, as a result of withdrawal of water from the given aquifer a reversal of the hydraulic gradient may occur, inducing recharge to the aquifer from the other reservoirs. Recharge from a new source modifies the quality of water in an aquifer and, in time, the water tends to resemble that of the new source.

Pumping from water-table aquifers often has an indirect effect on the quality of the water as a result of chemical reactions in the dewatered zone. Lowering of the water-table exposes mineral and organic matter to oxidation and carbonation. Some of the products of oxidation are taken into solution and transported to the water table by downward-percolating water.

Standards of chemical quality differ according to the use of the water. Properties that make a water unfit for domestic use may have no appreciable effect on its utility for certain industrial uses. The converse also may be true.

In general, the commonest constituents present in ground water are calcium, magnesium, iron, bicarbonate, carbonate, sulfate, and chloride, together with dissolved carbon dioxide gas. Calcium (Ca) and magnesium (Mg) account for most of the hardness in water—carbonate or "temporary" hardness when associated with bicarbonate (HCO_3) or carbonate (CO_3), and noncarbonate or "permanent" hardness when associated with sulfate (SO_4), chloride (Cl), or other anions. Water that contains large amounts of magnesium and chloride, or of carbon dioxide (CO_2) in solution, may be corrosive. Iron (Fe), in places accompanied by manganese (Mn), causes stains on textiles and fixtures if the combined concentration is greater than about 0.3 part per million, and may cause clogging of the distribution system if the concentration exceeds 1 ppm.

Organic pollution is not a serious problem in most ground-water supplies because of the natural filtering action of the minute openings in the rock. However, wells that tap solution channels in calcareous rock are liable to serious contamination if recharge is derived from a polluted source, because the water moves relatively freely and rapidly through the open channels with little filtration.

Physical Quality

So far as utility is concerned, temperature is the most important physical characteristic of ground water. Under natural conditions the temperature of ground water fluctuates only slightly and is about equal to the temperature of the source rock. At shallow depths the rock temperature follows the daily and seasonal fluctuation of the air temperature, but the amplitude of the fluctuations decreases rapidly with depth and becomes negligible below a depth of 20 or 30 feet. The temperature near the base of the zone of seasonal fluctuation is commonly 2°F or 3°F higher than the mean annual air temperature of the region. Below that zone, the earth temperature increases according to the geothermal gradient, which commonly averages about 1°F for each 50 to 100 feet of depth.

Natural temperatures may be changed significantly by artificial factors. In areas where wells are largely supplied by induced infiltration from a surface source, the temperature of the ground water fluctuates in response to changes in the temperature of the surface supply. The use of wells for disposal of used water or other wastes also may cause appreciable fluctuations of the ground-water temperature, and heat transfer into the ground from large industrial installations may considerably elevate the temperature of shallow ground water in the immediate area.

The chemical and physical characteristics of water from the different aquifers that underlie Bucks County are described in the following section of this report in the discussion of the hydrology of the individual aquifers. Analytical data are given in tables 2 through 6.

Summary

From the foregoing it follows that a detailed description of an aquifer must include data on the inherent hydraulic characteristics of the water-bearing material—that is, the capacity of the naturally occurring rock to store and transmit water; data on the occurrence of water in the aquifer—the source of recharge, the movement of the ground water, and location of points of discharge; and data on the quality of the water.

In the following section of this report the hydrologic properties of each formation are described according to the above criteria. The hydraulic constants have not been determined by quantitative field tests, but estimates based on tests of similar rocks in other areas are given for each of the formations. Statistical summaries of reported yields of wells also are included. It should be emphasized that statistical descriptions based on reported yields do not generally reflect the maximum yields of the wells covered by the survey. Reported yields are commonly expressed in terms of the actual rate of withdrawal made to satisfy the owners' requirements. Thus a well may be capable of yielding 200 gallons per minute, but if the owner's need is only 50 gallons per minute this figure is usually reported as the yield. Furthermore, even if the actual withdrawal approximates the maximum yield of a well, it may not be an accurate approximation of the maximum yield available from the formation at the selected site, because drilling is usually stopped as soon as the well yields sufficient water to meet the owner's needs. In many places, if the well were deepened the yield might be increased appreciably.

THE GEOLOGIC FORMATIONS AND THEIR WATER-BEARING CHARACTERISTICS

Bucks County is underlain by rocks that range in age from Precambrian to Recent. In the following pages the descriptions of formations are grouped according to the hydrologic characteristics of the beds, not according to their stratigraphic position.

This report is a cooperative product of the U. S. Geological Survey and the Pennsylvania Geological Survey. The classification and nomenclature of the rock units accord for the most part with that of the two Surveys but differs in some details from that of the U.S.G.S.

Crystalline Rocks

Geology of the Crystalline Rocks

Precambrian Rocks

Franklin limestone. The Franklin limestone occurs as lenses of massive crystalline limestone in the Baltimore gneiss. It has been described by Hall (1934) as follows:

> "The Franklin limestone is a coarse crystalline limestone, or marble, the individual particles of calcite being, in some places, as much as an inch in diameter. Graphite in small bright flakes approximately ⅛ inch in diameter is scattered through the marble and in most places the graphite is accompanied by flakes of the brown mica known as phlogopite. In some areas numerous silicate minerals are associated with the calcite.
>
> No bedding planes are visible in the Franklin limestone outcropping in Pennsylvania, and therefore strike, dip, and thickness are undeterminable. However, it is probable that the maximum thickness does not exceed a few hundred feet."

The only exposure of the Franklin limestone in Bucks County is in Lower Southampton Township in an abandoned quarry about a mile east of Ruxton.

Gneiss. Gneiss of Precambrian age crops out in about 20 square miles, or about 3 percent, of the total land area of Bucks County. It occurs also beneath much of the area of unconsolidated deposits in the extreme southeastern part of the county, at depths ranging from 1 to 300 feet or more. It is the oldest rock extensively exposed in the county.

Gneiss crops out in two rather narrow belts, both of which trend approximately northeast-southwest, one crossing the extreme northern corner and the other crossing the southeastern end of Bucks County. The major occurrence of gneiss is in southeastern Bucks County where the rock is mapped as the Baltimore gneiss. The gneiss in the northern corner of the county has been differentiated into two formations, the Pochuck hornblende gneiss and the Byram granite gneiss, but they are mapped as a single unit on plate 1.

The Baltimore gneiss is a medium-grained crystalline rock which probably is partly of sedimentary origin and partly of igneous origin. Two conspicuous facies of the Baltimore gneiss occur in Bucks County. The rock grades from a white or light-gray felsic gneiss, almost a pure quartz-orthoclase rock, to a dark-gray mafic gneiss which contains relatively large amounts of plagioclase feldspar and ferromagnesian minerals. Either variety may be characterized by massive or banded structure, but the banded rock is more common in Bucks County. The occurrence of the felsic and mafic varieties is shown on plate 1, but owing to the gradational character of the facies change, no contacts are indicated.

The following description of the Baltimore gneiss is taken from Bascom, Darton, Kummel and others (1909):

> "The Baltimore gneiss is a medium-grained, thoroughly crystalline aggregate of quartz, feldspar, and biotite, and may be either quite massive or characterized by pronounced banding. Within the Trenton quadrangle the gneissic type is relatively more important. The finely gneissic character of the rock is due to the alternation of layers of biotite with quartz or quartz feldspar. Biotite occurs in minute plates, but is nowhere developed in such dimensions or in such excess as to render the formation schistose. Associated with the biotitic layers are hornblende, epidote, titanite, garnet, and rounded apatite and zircon crysals. The feldspar is microcline,

orthoclase, and acidic plagioclase of about the composition of oligoclase and more or less completely altered to zoisite. Much graphite occurs, disseminated in pegmatitic material and in beds parallel to the gneissic structure, and has been mined in several localities in the Trenton quadrangle. . . . . .

The more granitic facies is only sporadically exposed. . . . . . It is medium grained and granular in texture. Quartz and feldspar are present in about equal proportions, with biotite, apatite, and zircon as accessory constituents, and zoisite and epidote as secondary products. The feldspar is chiefly orthoclase, clouded by zoisitization."

The Pochuck and Byram formations lie at the surface in an area of about 4 square miles in two approximately parallel ridges of Precambrian and Cambrian rocks that cross the extreme northern corner of Bucks County. These ridges are a part of the "Reading Hills" which are the Pennsylvania equivalent of the Jersey Highlands of northwestern New Jersey. The gneisses are not contemporaneous, the Pochuck is the older of the two. The Pochuck and Byram gneisses can be easily distinguished in the field, but they are so intricately interlayered that they are undifferentiated on the geologic map of Bucks County. (See pl. 1.)

The Pochuck gneiss is a conspicuously foliated, medium- to coarse-grained crystalline rock that was probably derived from a basic igneous intrusive. It is characteristically dark colored, ranging from dark green or gray to black. The chief mineral constituents are hornblende, pyroxene, biotite, and oligoclase, the latter being the only light-colored mineral commonly present.

The Byram gneiss is a coarse-grained crystalline rock that was apparently derived from a granitic intrusive. It may be easily distinguished from the associated Pochuck gneiss on the basis of color and structure. The Byram gneiss is a banded rock, but the banding is not as prominent as that of the Pochuck gneiss; the color ranges from light gray, where the rock is fresh, to buff or brown on weathered surfaces, and contrasts sharply with the more somber hues of the Pochuck gneiss. The principal mineral constituents of the Byram gneiss are quartz and potash feldspars; there are minor amounts of hornblende, pyroxene, and mica.

There is no general agreement regarding the origin and age relationships of the Precambrian rocks in Bucks County, but the Byram gneiss is commonly considered to be intrusive into the associated rocks.

Metadiabase. The Baltimore gneiss is penetrated locally by dikes of diabase, a basic igneous rock, which have been altered to metadiabase. It is composed chiefly of augite, hornblende, biotite, garnet, and plagioclase feldspar. Many of the dikes show the original diabasic texture but others have been crushed and the rock has been altered to mylonite. The dikes are believed to be Precambrian, as none have been seen to cut Paleozoic rocks.

Late Precambrian or Early Paleozoic (Undifferentiated)

Wissahickon schist. The Wissahickon schist is exposed at the surface in an area of about 10 square miles in southeastern Bucks County. In addition, it underlies Quaternary deposits in an area comprising about 20 square miles between the outcrop of the formation and the Delaware River which marks the eastern and southern boundaries of the county. The Wissahickon schist, like the Baltimore gneiss, is considered the basement rock throughout the area of its occurrence.

Crystalline Rocks

The lithology of the Wissahickon schist varies greatly in both horizontal and vertical sections. The formation is generally believed to have been originally a sedimentary deposit composed chiefly of beds or lenses of sandstone, shale, and arkose. Although these materials have been deformed and recrystallized by subsequent metamorphism, the original banding of the sediments has been largely retained. In its present occurrence the Wissahickon is a medium- to coarse-grained foliated crystalline rock ranging in texture from gneiss to schist. It consists of alternating layers of mica schist and quartzite which range in thickness from less than an inch to several feet. The important mineral constituents of the rock are mica, feldspar, quartz, chlorite, and garnet. Chlorite is abundant in the schistose beds, and feldspar in the gneissic beds, but mica is generally the most conspicuous mineral in any exposure of the Wissahickon schist.

Hornblende schist. Coarsely crystalline hornblende schist occurs as conformable sheets in association with the Wissahickon schist. The hornblende schist is believed to be an altered basic igneous intrusive, but no petrographic studies of this rock have been made. The rock is composed of hornblende, quartz, and feldspar, chiefly orthoclase, the hornblende accounting for nearly 50 percent of the mass. Owing to the abundance of the hornblende, the rock is characteristically a uniform dark gray or green in color in all exposures.

Altered ultrabasic rocks. Peridotite, pyroxenite, and allied ultrabasic igneous rocks intrude the Wissahickon schist in a number of places in southeastern Pennsylvania. Only one such occurrence is shown on the geologic map (pl. 1), but others undoubtably exist at depth within the rock, or beneath the unconsolidated deposits that cover much of the formation. Therefore, the following discussion is not restricted to Bucks County but is intended to summarize the occurrence of the ultrabasic rocks in adjacent areas as well.

The original ultrabasic rocks have been largely altered, and the original rock-forming minerals are preserved only in the cores of some of the larger dikes. Serpentine is generally the principal alteration product, but in a few places talc, anthophyllite, or chlorite is dominant. Associated with the serpentine are a great variety of minerals, some of which are relatively rare to the area. Tremolite, hornblende, actinolite, epidote, clinochlore, vermiculite, pectolite, breunnerite, quartz, chalcedony, opal, chromite, steatite, magnetite, hematite, limonite, calcite, and corundum commonly occur as primary or secondary constituents in the ultrabasic dikes.

Granite gneiss. The Wissahickon schist includes granitized zones which are generally believed to represent igneous intrusions, although some investigators consider them to be metamorphic facies of the formation. The rocks of this type range in composition from granite to granodiorite, and in texture from massive to schistose.

Occurrences of the granite gneiss in Bucks County have not been adequately described, but in adjacent areas the rock is commonly a medium- to coarse-grained porphyritic gneiss. It consists chiefly of quartz, feldspar, biotite, and hornblende. The gneissic phase is predominant, but this may give way to massive rock with distance from formation contacts. Schistose structure is common near the contact with the associated Wissahickon schist.

Cambrian System

Cambrian rocks are exposed in three widely separated areas in Bucks County: in the Durham area in the extreme northern corner of the county, in the Buckingham area in the east-central part of the county, and in the so-called Langhorne area in southeastern Bucks County. The three areas are similar in that each is a narrow belt trending approximately northeast-southwest and each is bounded on the south by a major thrust or normal fault along which vertical displacement has brought the Paleozoic rocks to the surface. The areas differ with respect to the thickness and lithology of the beds exposed, but the beds are, in general, contemporaneous.

Hardyston and Chickies quartzites. The Hardyston and Chickies quartzites are the oldest Paleozoic sedimentary formations exposed in Bucks County. Taken together, the quartzite formations underlie only about 7 square miles, approximately 1 percent of the surface area of Bucks County. However, they are the most easily recognized Paleozoic rocks in the area.

The Chickies quartzite underlies a narrow belt extending entirely across southern Bucks County from Trevose through Langhorne to Morrisville. It lies also at the southeastern margin of the Paleozoic rocks in the Buckingham area. No diagnostic fossils have been found in the Chickies quartzite in Bucks County, but it is believed by most authorities to be of Early Cambrian age, on the basis of correlations with other areas where the beds are fossiliferous. It is a massively-bedded vitreous quartzite in which the individual quartz grains are clear white or blue. The formation weathers to a buff or gray color. The upper part of the formation is locally thin bedded and weathers to a siliceous clay.

The basal part of the Chickies quartzite is formed by the Hellam conglomerate member, which consists chiefly of elongated blue quartz pebbles and pink feldspar fragments in a matrix of granular quartzite or arkose.

The average reported thickness of the Chickies quartzite in southeastern Pennsylvania is about 400 feet, but this figure probably does not include the thickness of the Hellam member. In Bucks County the observed thickness of the Chickies, including the Hellam member, ranges from about 900 feet in the Buckingham area to about 1,300 feet in the Langhorne area. In both the Buckingham and the Langhorne areas the Chickies rests in normal depositional contact on crystalline rocks of Precambrian age. In the Buckingham area there appears to be a gradual transition from quartzite into the overlying limestone. In the Langhorne area the top of the Chickies is not exposed. The Chickies is separated from the Wissahickon schist by a thrust fault.

The Hardyston quartzite occurs in the physiographic region known as the Reading Hills in the northernmost corner of Bucks County. It is believed by most authorities to be contemporaneous with the Chickies, but paleontological evidence that would enable positive dating and correlation is lacking.

The lithology of the Hardyston quartzite is similar to that of the Chickies quartzite except that no well-developed conglomerate similar

to the Hellam member is present at its base. Rather, thin beds of conglomerate occur throughout the Hardyston.

The structural and stratigraphic mode of occurrence of the Hardyston in the Reading Hills is almost identical with that of the Chickies in the Buckingham area. The base is in normal sedimentary contact with the underlying crystalline rocks of Precambrian age and the upper contact is generally thought to be transitional into the overlying limestone of Cambrian age. It is bounded on the south by a major normal fault which separates the beds of Cambrian age from beds of Triassic age.

In the Durham area the Hardyston quartzite ranges in thickness from less than 100 feet to about 300 feet. This conforms with the general belief that the quartzite beds of Early Cambrian age are contemporaneous, but that the aggregate thickness of the beds increases to the south as the result of the addition of the Hellam member to the sequence. It has been theorized that the quartzite rocks of Early Cambrian age were deposited during the first invasion of Paleozoic seas into the Appalachian geosyncline.

Ordovician System

Cocalico phyllite. The Cocalico phyllite is exposed in a small triangular area west of Furlong in Buckingham Valley. It is a dark-colored platy to finely laminated rock that ranges in texture from phyllite to slate. In some exposures the phyllite exhibits a faint bedding that apparently dips gently to the north beneath the sedimentary rocks of Triassic age.

The Cocalico phyllite is in fault contact with limstone of Cambrian age on the east, and with shale of Triassic age on the south. To the north and west it unconformably underlies sandstone of the Stockton lithofacies of Triassic age. Beds of the Cocalico phyllite having a stratigraphic thickness of about 200 feet are exposed in the area, but the total thickness of the formation is unknown, as neither the upper nor the lower contact is exposed in the area.

Triassic System

Diabase. Beds of Late Triassic age, particularly the Brunswick lithofacies, are extensively intruded by diabase, popularly known as traprock. Diabase occurs in nearly vertical dikes which cut across the bedding of the sedimentary strata, and in sills which commonly are conformable with the bedding. As the diabase has greater resistance to erosion than the sediments, it form conspicuous ridges where dikes are exposed and prominent uplands where sills are exposed.

The lithology of the diabase is remarkably uniform from place to place. It includes nearly equal amounts of plagioclase feldspar and augite, and ilmenite, quartz, and apatite as accessory minerals. Diabase rocks weather to boulders which, when exposed, are often covered with a rust-colored oxidized coat; fresh surfaces are greenish gray in color and have a conchoidal fracture. The texture of the diabase varies somewhat according to its mode of occurrence. In the thinner dikes the rock may be exceedingly fine grained, but the larger dikes and sills consist of medium- to coarse-grained rock that closely resembles granite.

The diabase intrusions occurred late in the Triassic period, near the end of the Brunswick deposition. They cut rocks that range in age from Precambrian through Triassic, but they do not share in any of the crustal movements that occurred prior to the Triassic period.

The diabase intrusives are correlative at least in part with basaltic lava flows that are interbedded with beds in the upper part of the Brunswick lithofacies in central New Jersey. The diabase and balsalt probably had a common magmatic source. They are chemically identical and differ from one another only in texture, because the diabase solidified before reaching the land surface.

Water-Bearing Characteristics of the Crystalline Rocks

Although the crystalline rocks differ greatly in origin and in most of the chemical and physical characteristics which are used in describing rocks, their basic hydrologic properties are generally similar. All are dense, massive rocks which, in their original state, are relatively impervious to water. Essentially all ground water in the crystalline rocks occurs under water-table conditions in the weathered zone near the land surface, where openings resulting from faulting and jointing have been enlarged by frost action, the roots of vegetation, and solution of the rock-forming minerals by circulating ground water. These cavities constitute only a small part of the total volume of the rock, but they provide for the storage and movement of considerable quantities of ground water.

The forces of weathering are most effective at the rock outcrop. With depth the water-bearing cavities decrease in size and number, as the weathered material grades into unaltered rock. The weathered zone is thickest in areas of low to moderate relief; it is best developed in valleys because there is continuous circulation of ground water in the vicinity of streams, which are the principal localities of natural discharge of ground water. The weathered zone is least thick, and may be absent, in areas of high relief. Judging from records of drilled wells, the maximum thickness of the weathered material commonly does not exceed about 150 feet, and yields of wells are not appreciably increased by drilling below that depth. Most successful wells obtain their supplies from the zone of partly weathered rock that lies between the disintegrated rock at the land surface and the fresh rock at depth. A few wells are reported to obtain water from depths of 500 feet or more, probably from faults, exceptionally large joints, or shattered quartz veins. Successful deep wells are the exception, however, and their aggregate yield does not constitute an appreciable part of the ground-water supply.

The storage coefficient of the crystalline rocks is in the low range of water-table values. It probably ranges from about 0.005 to about 0.02. The specific capacity of wells that tap the crystalline rocks is also moderately low to very low, as shown in the following table of reported specific capacities of wells.

Formation	*Number of wells*	*Average specific capacity*	*Range in specific capacity*
Wissahickon schist	8	1.70	0.17 - 5.0
Gneiss	3	2.69	1.27 - 5.29
Quartzite	2	1.80	.23 - 1.67

Crystalline Rocks

From an analysis of the hydraulic characteristics of the crystalline rocks it is apparent that a typical well that taps these beds will exhibit appreciable drawdown at any pumping rate, but the effect of the withdrawal will not be transmitted any great distance from the well, probably no more than a few hundred feet in most localities, unless the yield and rate of pumping are high.

In some areas the ground water may be semiconfined in the partly altered rock that occurs between the decomposed material at the surface and the fresh rock; or it may be confined in fault zones that occur at considerable depth in the fresh rock, or in the weathered rock that underlies the unconsolidated fill in the valley of the Delaware River. The upper part of the crystalline rock beneath the valley commonly consists of decomposed rock that serves as a confining bed on the underlying partly altered rock. Where the confining bed is continuous beneath the unconsolidated deposits, the water in the crystalline rock has a definite gradient riverward from the Fall Line. A few wells drilled through the valley fill into the crystalline rock have flowed at the surface. In most places, however, the confining bed is discontinuous and there is interchange of water between the crystalline and unconsolidated rocks. In these areas the water level in a well that taps crystalline rocks is about the same as the water level in a nearby well that taps unconsolidated beds. Occurrences of semiconfined conditions have little effect on the regional hydrology of the crystalline rocks, however, because their influence is local.

The crystalline rocks of Precambrian age, particularly the gneisses, schists, and quartzites, are reliable sources of small to moderate supplies of ground water. Little is known of the water-bearing characteristics of the Cocalico phyllite, but it appears to be a less favorable source of water supply than the other crystalline rocks. The reported yields of wells that tap gneiss, quartzite, and the Wissahickon schist are summarized in the following table.

Formation	*Number of wells*	*Range in yield (gpm)*	*Average yield (gpm)*
Wissahickon schist	12	2 - 200	45
Gneiss	16	2 - 200	42
Quartzite	31	1 - 125	38

As to chemical quality, the crystalline rocks of Precambrian age yield the most desirable ground water available in Bucks County. The water commonly is low in dissolved solids and hardness, and is free of objectionable mineral matter except iron, which may be present in concentrations that exceed the generally accepted limit of 0.3 part per million.

Analyses of representative samples of water from gneiss, quartzite, and the Wissahickon schist are given in table 2.

Special mention should be made of the water-bearing characteristics of diabase because it underlies a larger area of Bucks County than all other crystalline rocks combined. Diabase is the poorest aquifer in Bucks County—so poor, in fact, that many drillers will not accept contracts to make wells in this formation. The thickness of the weathered zone in diabase seldom exceeds about 75 feet and probably averages no more than 50 feet. Wells generally obtain their yields from depth of 50 feet

TABLE 2.—Analyses of Water From Crystalline Rocks

(Parts per million. Numbers correspond to numbers in tables of well data for the counties)

Well No.	Location	Date	Silica (SiO_2)	Iron (Fe)	Total iron	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Non-carbonate	Specific conductance (at 25°, micromhos)	pH	Temperature (°F.)
								Wissahickon Formation												
Bk-462	OKO Plush Co., Inc.	4-28-53	24	.03	3.4	4.1	1.7	8.3	2.4	26	9.1	5.4	.1	.3	72	17	.0	76.3	5.9	57
Bk-471	Hi-Way Pool, well 1	9-8-53	13	.05	.27	14	9.9	10	2.4	16	18	40	.0	25	171	76	63	265	5.5	55
Bk-488	Frank J. Lotz	4-28-53	12	.04	.04	22	9.1	21	4.4	26	48	34	.1	30	246	92	71	384	5.2	54
Bk-585	Hunter Manufacturing Corp., well 2	4-16-53	19	.02	.36	20	3.6	8.5	2.8	38	41	8.0	.1	1.9	127	65	34	176	6.1	53
Bk-498	Publicker Industries, Inc.	1-21-54	20	.06	.15	14	8.3	7.4	2.8	26	18	16	.1	34	154	69	48	198	6.9	58
Bk-610	Fairless Hills, well 5	4-24-53	20	.04	.06	4.5	2.2	2.2	1.3	8	1.6	5.5	.1	13	58	20	14	67.9	5.3	52
Bk-612	Fairless Hills, well 7	4-24-53	20	.04	1.3	8.1	4.0	5.4	2.2	40	13	4.0	.2	.8	90	37	4	111	6.0	53
								Gneiss												
Bk-436	Yardley Water & Power Co., well 5	4-9-53	15	.02	1.1	18	7.0	16	3.3	106	9.5	8.0	.1	5.8	138	74	.0	211	6.8	54
Bk-451	Parkland Water Co., well 2	4-8-53	13	.02	.41	10	2.4	6.0	1.3	38	2.8	9.0	.0	3.8	78	35	4	100	5.3	53
Bk-454	Parkland Water Co., well 5	4-15-53	11	------	------	------	------	4.6		20	14	14	------	13	------	48	35	156	5.7	53
Bk-456	Langhorne Spring Water Co., well 2	9-7-53	8.7	.06	.29	2.9	1.3	5.0	1.3	8	.3	7.0	.0	7.9	51	13	6	63.6	5.4	53
Bk-621	Bucks County Farms Dairies, well 1	4-30-53	17	.05	.10	7.4	5.0	4.7	2.0	23	11	11	.1	7.4	92	39	20	120	7.2	54

Quartzite																				
Bk-340	Walter M. Reiff	4-14-53	8.9	.04	.18	4.3	2.0	5.6	2.2	15	2.3	8.2	.0	10	55	19	7	81.5	5.2	53
Bk-395	Somerton Springs Swimming Club	4-28-53	17	.04	.18	9.1	2.9	6.1	1.2	29	5.1	6.9	.0	13	85	35	11	108	5.9	53
Bk-453	Parkland Water Company	4-15-53	15	.03	.03	35	6.6	8.8	4.4	100	26	14	.0	13	191	114	33	290	6.4	53
Bk-458	Langhorne Spring Water Company	9-7-53	17	.06	1.6	25	5.1	4.5	3.8	80	13	8.0	.4	.3	122	83	18	206	7.1	53
Diabase																				
Bk-97	Milford Square Pants Company	4-20-53	18	.04	1.4	48	15	11	2.3	196	34	8.5	.1	3.7	247	181	21	384	7.3	52
Bk-136	Sellersville Borough, well 1	4-8-53	25	.01	.4	94	9.1	4.4	1.0	126	169	2.2	.1	.3	398	272	169	536	7.5	55

or less, and the maximum depth from which a well in diabase in the county is reported to obtain water is 125 feet. The capacity of diabase to store and transmit water is extremely low, and many wells are failures. No specific-capacity tests are available for wells that tap diabase, but the average specific capacity is probably only a fraction of a gallon per minute per foot of drawdown of water level. The reported yields of five wells in diabase range from 2 gpm to 45 gpm and average 23 gpm. However, this accounting is based only on successful wells. If failures are included, the average yield of wells is probably less than 5 gpm.

The water from the diabase generally is moderately mineralized and hard, and sometimes has objectionable amounts of iron in solution. Some samples contain relatively high concentrations of sulfate and have corresponding high noncarbonate hardness. Analyses of two representative samples of water from diabase are given in table 2.

Geology of the Carbonate Rocks

Cambrian System

The nomenclature and correlation of the limestones of Cambrian age in Bucks County are subject to technical controversy. Bascom, Clark, Darton, and others (1909) mapped the entire sequence of limestone deposits, including those of Ordovician age, as a single unit which they called the Shenandoah limestone. In a later investigation Bascom, Wherry, Stose, and Jonas (1931) subdivided the Shenandoah limestone in the Buckingham area into three mappable units which they correlated with the Beekmantown limestone, of Ordovician age, and the Conococheague and Elbrook limestones, of Cambrian age. Other investigators used the names Tomstown or Leithsville in place of Elbrook, and Allentown in place of Conococheague. Howell, Roberts, and Willard (1950) took exception to previous interpretations of the stratigraphic sequence of the Cambrian limestones of Bucks County, chiefly because the beds had not been systematically traced from type areas into eastern Pennsylvania. They proposed the following local terminology, the formational names being given in descending order: Allentown (restricted), Limeport, and Leithsville. The Allentown and Limeport in this restricted definition are equivalent respectively to the upper and lower parts of the Conococheague limestone, and the Leithsville is equivalent to the Elbrook or Tomstown formations. This terminology was used in the text of the report on Bucks County by Willard, McLaughlin, Watson, and others (unpublished manuscript); but on their geologic map, which is also used for this report, they retain the nomenclature of Bascom, Wherry, Stose, and Jonas (1931) for the Buckingham area, and do not differentiate between the various beds in the Durham area except to show two narrow belts of the Tomstown formation (Leithsville) along the Triassic border fault.

In view of the obvious uncertainty regarding the identification and correlation of the Cambrian limestones, and to be consistent with both the accompanying geologic map and current terminology as defined by Willard, McLaughlin, Watson, and others, the formations are discussed below as shown on the geologic map.

Elbrook (?) limestone (Leithsville, Tomstown). The Elbrook (?) limestone occurs in both the Buckingham and Durham areas in Bucks County. It is undifferentiated in the Durham area except where two small occurrences of equivalent rocks are mapped as the Tomstown formation. It is light blue to gray in color, nonfossiliferous, and dolomitic; and it includes some beds of red and gray shale. There are local occurrences of black chert, quartz sand, and edgewise conglomerate, and a few of the beds show mud cracks and ripple marks. The character of the bedding is the chief distinguishing feature of the formation. It has a cyclic stratigraphic sequence from thick, massive strata, commonly finely laminated, to thin, shaly, sericitic layers. Residual soils derived from the latter are full of shiny mica fragments.

The contact between the Elbrook (?) limestone and the underlying quartzite is rarely exposed, but it is generally believed to be transitional. The upper contact of the Elbrook (?) limestone with the Conococheague limestone is probably exposed, but it cannot be defined sharply and is also believed to be transitional. As the upper and lower contacts are obscure, the thickness of the Elbrook (?) limestone is difficult to determine, but it is estimated to range from about 400 to 600 feet.

Conococheague limestone (Allentown, Limeport). The Conococheague limestone is exposed in both of the limestone belts in Bucks County, but it is mapped as a unit only in the Buckingham area. It is a massive, dense, light-blue to gray dolomitic limestone which includes numerous beds of sand and edgewise conglomerate, and occasional thin layers of shale. Ripple marks and mud cracks are rare. Large exposures commonly show alternating light and dark bands which probably reflect slight differences in the chemical composition of the rock.

The Conococheague is the only fossiliferous limestone in Bucks County. It contains several species of Cryptozoa which in many places are so abundant that they constitute the principal rock-forming material. These beds, called biostromes, are persistent over wide areas and occur throughout the Conococheague. The proposed divisions of the Conococheague limestone into the Limeport and Allentown (restricted) is based largely on paleontologic data. The algal forms found in the lower part of the Conococheague, or Limeport, are of early Late Cambrian age, whereas those associated with the upper part of the Conococheague, or Allentown (restricted), are of late Late Cambrian age. Middle Late Cambrian time apparently is represented only by an erosional break in about the middle of the Conococheague limestone.

The thickness of the Conococheague in Bucks County ranges from about 500 feet in the Buckingham area, where only the Limeport occurs, to about 900 feet in the Durham area where both the Limeport and Allentown occur. The lower contact is transitional, and in any given exposure it is identified as the point below which the rhythmic repetition of bedding of the Elbrook (?) limestone gives way to the more massive beds of the Conococheague. The contact of the Conococheague limestone with the overlying Beekmantown (?) limestone is similarly obscure. In the Durham area the contact cannot be defined because the Beekmantown (?) limestone is missing from the section. In the Buckingham area the local occurrence of a bed of red shale at the top of the Limeport formation

is believed to mark the contact of Cambrian and Ordovician rocks. Where the red-shale bed is missing, the top of the Conococheague limestone cannot be identified with accuracy, and in those localities it is commonly placed above the sequence that includes Cryptozoa beds and zones of alternating light- and dark-banded rock.

Ordovician System

Beekmantown (?) limestone. The Beekmantown (?) limestone overlies the Conococheague limestone in two narrow belts along the northern edge of the Buckingham Valley. It is a massive, fine-grained dolomitic limestone generally gray to blue in color. It includes some distinctly siliceous zones and occasional thin beds of shale, and it is devoid of fossils. The Beekmantown (?) limestone is easily differentiated from the fossiliferous underlying limestones of Late Cambrian age and it is more massive and contains less sand than the Conococheague limestone.

According to Willard, McLaughlin, Watson, and others (unpublished manuscript) the Beekmantown in Buckingham Valley is estimated to be about 1,000 feet thick. The thickness cannot be determined accurately because the upper and lower contacts of the formation are difficult to establish. The contact with the underlying Conococheague is disconformable, as described in the discussion of the limestones of Late Cambrian age. The upper contact of the formation is concealed beneath the overlying Triassic sedimentary rocks, but it is known to be marked by a profound unconformity.

Water-Bearing Characteristics of the Carbonate Rocks

The calcareous rocks are similar to the crystalline rocks in that they have almost no primary porosity. But, owing to earth movements and destructive weathering processes, they commonly contain numerous secondary openings in the weathered zone near the land surface. Solution is the chief weathering agent in calcareous rocks. Limestone and dolomite are relatively soluble in water that is only slightly acid in reaction. Rainfall contains carbon dioxide dissolved from the atmosphere, making it a weak carbonic acid, and the acidity of the water is increased by solution of more carbon dioxide and of organic acids from the soil. Thus natural water is an effective solvent of carbonate rock, and where it moves along zones of weakness, such as joints or faults or bedding planes in the calcareous rock, it may erode solution channels or openings of considerable size and extent. The occurrence of the solution openings is extremely irregular. They are most numerous between depths ranging from 50 feet to about 300 feet, but some wells are reported to have penetrated large openings at depths of more than 1,000 feet. However, in Bucks County it is seldom practicable to drill deeper than about 500 feet in search of water in calcareous rocks.

Ground water occurs in the calcareous rocks under both water-table and artesian conditions. Water-table conditions prevail in the shallow aquifers, and the conditions of occurrence resemble those in the water-table aquifers of crystalline rock, except that the calcareous-rock aquifers probably have higher coefficients of storage and permeability.

Water-Bearing Characteristics

Ground water occurs under semiartesian and artesian conditions in solution openings in the calcareous rocks. The solution channels are recharged from the overlying water-table aquifers, or from sinks (undrained depressions) at the land surface. They may transmit the water many miles from the locality of recharge to points of discharge, but the channels may not be oriented in any recognizable pattern. Their occurrence cannot be predicted in advance of drilling; consequently it is often necessary to drill several wells at a selected location to obtain one successful supply well. The abundance of solution openings is usually greater near surface-drainage lines. In limestone terrane the surface drainage is commonly controlled by the concentration of subsurface solution openings. Therefore stream valleys, topographic depressions, or lines of sinkholes are favorable locations in which to drill wells in limestone.

The coefficient of storage of calcareous rock aquifers, except near the surface where water-table conditions prevail, probably ranges from about 0.001 to 0.0001. The average permeability is apparently high. No records of specific-capacity tests are available for wells in Bucks County tapping limestone, but well owners commonly report high yields with only moderate drawdowns of water level.

Calcareous rocks display perhaps more heterogeneity in their hydrology than any other rock type. From the calculated hydraulic characteristics of an aquifer it might appear that a typical well would exhibit low to moderate drawdown at any discharge rate, but that a decline of water level as an effect of pumping would be transmitted rapidly to relatively distant points throughout the aquifer. This effect does occur, of course, but it is seldom transmitted equally in all directions—it follows the courses of the interconnected solution openings tapped by the pumped well. Consequently, in limestone terrane, two nearby wells may tap different systems of openings in the rocks. Under these conditions, there is little or no mutual interference between the wells as a result of pumping from either.

Successful wells in areas underlain by calcareous rocks supply the largest yields obtained from wells that tap consolidated-rock aquifers in Bucks County. Records are available for only four such wells, but they range in yield from 5 gallons per minute to 750 gallons per minute, and their average yield is over 350 gallons per minute.

No water from wells tapping calcareous rocks was sampled for chemical analysis in connection with this study. The following discussion of the chemical quality of water in limestone aquifers in southeastern Pennsylvania is taken from Hall (1934).

"Analyses were made of a total of 41 waters obtained from limestone, dolomite, and marble, chiefly from the calcareous formations of the Cambrian and Ordovician systems. Nearly all of these waters are fairly high in total dissolved solids, their mineral contents consisting largely of the bicarbonate of calcium and magnesium, which give them considerable hardness. The 41 samples ranged in total solids from 75 to 889 parts per million but nearly three-fourths of them were between 200 and 500 parts and their average content of dissolved solids was 304 parts. The same samples ranged in hardness from 24 to 508 parts per million, nearly two-thirds of them having between 100 and 250 parts and nearly one-third having more than 250 parts of hardness. They showed an average hardness of 239 parts per million. The limestone waters are generally low in iron, only 2 of the 41 samples having more than 1 part per million and over half of them having less than one-tenth of

1 part per million of this undesirable constituent. Except for their hardness the limestone waters are as a rule excellent waters.

Wells deriving their water from solution channels are liable to serious contamination because of the rapidity with which the water moves along the channels. Care should therefore be taken in choosing a site for a well that is near sources of pollution."

Geology and Hydrology of the Triassic Rocks

Rocks of Triassic age play an important part in the geology of the northeastern Atlantic seaboard from Nova Scotia to North Carolina. The character and occurrence of the deposits are remarkably similar throughout this area. All the Triassic rocks occur in structural basins elongated in a north-south or northeast-southwest direction. In general they consist of thick sequences of nonmarine sediments, predominantly red to brown in color. The sediments are intruded by diabase dikes and sills in many areas, and the upper strata are commonly interbedded with thick flows of basaltic lava. The beds frequently occur in large blocks that are tilted and separated from one another by normal faults. The underlying rocks range in age from Precambrian to Carboniferous, but they are always separated from the Triassic rocks by a profound unconformity.

The Triassic sedimentary rocks and interbedded lava flows constitute the Newark group, which was named for exposures in the vicinity of Newark. The igneous intrusives also are of Triassic age, but because they are not conformable with the stratified rocks, they are not included as part of the Newark group, and are at least in part of later origin.

Newark Group

Owing to the similarity of the lithology, structure, stratigraphic relations, and fossil content of the Triassic rocks, the term Newark group is applied to all occurrences of these rocks in northeastern North America. However, it has not been possible to subdivide the group into formations or members that can be correlated from one basin to another, or even throughout any of the larger basins. Deposition was largely controlled by local environment, and similar conditions apparently occurred at different times in different areas.

The diabase does not have a name common to all areas of occurrence. It may carry a local name, but it is generally referred to simply as "traprock."

The Newark group is believed to be of Late Triassic age. This correlation is based in part on paleontologic data, and in part on structural and stratigraphic evidence. Fossil plants and animals correspond within general limits to European forms, but it has not been possible to correlate equivalent beds in the European and American strata. The Newark group rests unconformably on older rocks, and it shows no effects of the structural deformation that occurred at the end of the Paleozoic era. On the other hand, the Newark group is distinctly older than the Cretaceous deposits. Rocks of the Newark group were intruded by diabase, then faulted and tilted, and finally peneplaned before deposition of Lower Cretaceous sediments.

Triassic rocks are a dominant feature of the geology of Bucks County. The Newark group underlies nearly three-quarters of the total land

area, and diabase dikes and sills underlie an additional tenth of the county. Except for the isolated areas of Cambrian rocks in the Buckingham and Durham valleys, the Triassic deposits form the land surface of all Bucks County north of the Precambrian border near Langhorne.

The Newark group and associated intrusives in Bucks County occur in part of the largest belt of Triassic rocks in northeastern North America. The deposits occur in a broad, downfaulted intermontane basin that extends from southeastern New York State across New Jersey, southeastern Pennsylvania, and central Maryland into northern Virginia. The belt is broadest in Bucks County, where it attains a width of 32 miles.

In Bucks County the Newark group consists chiefly of interbedded red shale and red sandstone, with subordinate amounts of conglomerate, arkose, and argillite. No lava flows have been identified in the county, but they are known to occur to the west in Berks County, and to the east in New Jersey.

The origin of sediments of the Newark group has been the subject of considerable debate. The latest studies (McLaughlin, unpublished manuscript) indicate that they are products of the erosion of uplands that lay to both the north and the south of the outcrop area of the Triassic rocks. Arkose and conglomerate on the south side of the belt were derived from the crystalline rocks of Precambrian and Cambrian age that bordered the basin on the south. Sandstone, shale, and fanglomerate on the north were derived from the sediments of Silurian, Devonian, and Mississippian age that bordered the basin on the north. The beds are thickest in the center of the basin, which probably subsided during the period of deposition. They thin toward their areas of origin. On the side of the basin opposite from their sources the older beds pinch out against the floor of the basin, and the younger beds overlap the older rocks.

In the basin that extends from Virginia to New Jersey the great normal-fault blocks are tilted toward the northwest, and in Bucks County most of the Triassic strata dip in that direction at angles ranging from 5° to 20°. Folding is not a prominent feature, but near the large faults drag folds occur and beds have dips as great as 50°. Beds that underlie the large intrusive bodies in the northern part of the county are warped into gentle synclinal folds which lie superimposed on the regional monocline.

Estimates of the total thickness of the Newark group in Bucks County range from about 2,000 feet to more than 12,000 feet. The higher figure is favored by most investigators, but others claim that repetition of strata due to faulting gives the illusion of great thickness to deposits that are no more than 2,000 feet thick. McLaughlin (unpublished manuscript) estimates the thickness to be about 12,000 feet, after taking into account duplication of beds caused by major faults. He acknowledges the possibility of some error due to undiscovered minor strike faults, but he believes possible errors to represent only a small percentage of the total thickness, because there has been no significant displacement of major beds.

Kummel (1897) subdivided the Newark group into three lithologic units. They are, in ascending order, the Stockton sandstone, the Lockatong black argillite, and the Brunswick red shale, named after type localities in western New Jersey. A fourth rock type, the border conglomer-

ate, was identified as a facies of the other three units. The divisions established in New Jersey are applicable in Bucks County, but a short distance to the west they grade into a two-unit group. Each division of the Newark group was originally designated a series, but the three divisions have since been redefined as formations in reports of the United States Geological Survey. In describing the beds, Kummel recognized that they are interfingering sedimentary facies which represent rapidly changing conditions of local deposition, and have little significance as time markers. This interpretation was expanded considerably by McLaughlin (unpublished manuscrapt), who attributed the interfingering to derivation of the sediments from different sources, and he redefined the unit terms as lithofacies, as distinguished from formations, which commonly imply temporal limits. As geologic and hydrologic studies in Bucks County are closely related, the same nomenclature is used in this report. The individual lithofacies have been described as follows.

Stockton lithofacies. The Stockton lithofacies crops out in two areas in central and southeastern Bucks County. (See pl. 1.) The southern belt traverses the entire county in a general west-southwest direction. Its width is about 4 miles at the Delaware River, but it increases westward to about 6 miles at the Montgomery County line. The belt is bounded on the south by Precambrian rocks and on the north by the Lockatong lithofacies.

The central belt of the Stockton lithofacies trends southwestward across the county to Chalfont, where it is cut by a large normal fault. The belt narrows locally where the fault cuts diagonally across it. This central belt is bounded on the south by exposures of Paleozoic rock in the Buckingham area, on the west by the fault which separates the Stockton from younger Triassic rocks, and on the north by rocks of the Lockatong lithofacies.

The Stockton lithofacies consists of light-colored coarse-grained arkosic standstone and conglomerate, red to brown fine-grained siliceous sandstone, and red shale. In general, arkosic beds are more characteristic of the Stockton than is shale. The most conspicuous features of the beds are the dominant red color and the abundance of arkose throughout the section except in the uppermost beds. The different lithologies are interbedded in no regular order and are frequently repeated. Single beds rarely can be traced for any appreciable distance along an outcrop. They commonly pinch out, or grade into beds having different textures and/or compositions, but certain sequences of beds may persist for many miles. Some of the thick arkose and red sandstone beds can be identified at widely separated points.

The Stockton lithofacies weathers to an undulating topography of moderately low relief. Most of the valleys are eroded into the soft red sandstone beds, whereas the uplands are underlain by more resistant arkose. Owing to the irregular character of the bedding, topographic features are not commonly oriented in any systematic pattern, but locally, as in the central belt of the Stockton exposures, some of the ridges parallel the strike of the beds.

The rocks of the Stockton are cut by a well-developed system of joints and are extensively faulted. The beds commonly show ripple marks, mud

cracks, and raindrop impressions. Crossbedding, lensing, and pinch-and-swell structures are characteristic features of the bedding, particularly in the arkose and conglomerate deposits.

At any exposure the Stockton may exhibit every gradation in texture from arkosic conglomerate through fine-grained sandstone to red shale. But if the lithofacies is considered in its stratigraphic entirety, the beds show a gradation in texture and composition from coarse-grained, arkosic materials at the base to fine-grained siliceous materials at the top. According to McLaughlin (unpublished manuscript) the local interbedding of arkose, fine sand, and shale reflects temporary changes in the sources of the sediments to the individual beds; and the upward gradation in texture reflects a progressive shift in the locus of the primary source of the sediments with respect to the basin as a whole. Thus the local development of relatively thin interbedded sediments in the Stockton is a replica, on a miniature scale, of the conditions of deposition that resulted in formation of the Newark group.

From exposures along the Delaware River, McLaughlin (unpublished manuscript) prepared a composite section of the Stockton lithofacies for the central belt of occurrence. Thicknesses were computed largely from dip measurements, but were verified wherever possible by vertical sections exposed in quarries, and along valley walls. Thus, the computed thickness of 5,000 feet is believed to approximate the true thickness of the lithofacies. It was not possible to prepare a detailed section for the southern belt because of the scarcity of good exposures. However, a sufficient number of dip measurements were made to serve as a basis for estimating the average dip to be 8°, from which the thickness was computed to be about 3,000 feet. The apparent thinning toward the south thus determined supports the hypothesis that the Stockton lithofacies thins toward a southern source.

In Bucks County the thickness of the Stockton lithofacies is relatively uniform within each of the belts, but toward the west, beyond the limits of the county, the Stockton overlaps older crystalline rocks and thins to a minimum of about 1,000 feet in northern Chester County.

The Stockton lithofacies rests unconformably upon older rocks. In the southern belt it overlies the Baltimore gneiss of Precambrian age. In the central belt it overlies Cambrian and Ordovician limestone and phyllite. In both belts the Stockton is overlain conformably by the Lockatong lithofacies, with only local interfingering of beds at the contact between them.

The Stockton lithofacies is the best bedrock source of ground water in Bucks County. Weakly cemented coarse-grained clastic sediments constitute a large part of the formation. Ground water is contained in intergranular openings in the clastic sediments where the cementing material has been removed by weathering. Thus, the occurrence and movement of ground water in the Stockton are functions of the degree of weathering of the rock. The effectiveness of weathering decreases with depth, and the porosity of the Stockton has a corresponding decrease with depth, becoming negligible in the virgin rock below the weathered zone. The thickness of the weathered rock varies from place to place according to the topography, but it probably seldom exceeds about 500 feet, and it is not generally worth while to exceed that depth in drilling for water.

Ground water in the Stockton lithofacies commonly occurs under artesian conditions, chiefly in the sandstone and conglomerate beds that are interlayered with red shale throughout the formation. In some areas the artesian pressure is apparently a function of the bedding, the shale constituting the confining beds. These conditions are of only local significance, because the bedding is so lenticular and erratic that individual shale beds are not continuous for any appreciable distance, along either the dip or the strike of the formation. Furthermore, the dip of the bedding is so steep—averaging 10 degrees or more—that a selected bed is not water bearing for any appreciable distance down dip, as it grades into unaltered rock at shallow depth. The artesian pressure in the Stockton is more commonly related to vertical changes in permeability that occur in the formation. The cementing material is apparently less susceptible to solution in some zones than in others; furthermore, gradations in the texture of the sediments may account for significant vertical changes in permeability in the section. Thus the occurrence and movement of ground water in the Stockton lithofacies is largely controlled by the configuration of the base of the weathered zone and by vertical changes in the porosity and permeability of the sediments. Recharge to the ground-water reservoir percolates downward in localities where confining layers are absent, joins the body of ground water, and moves laterally, under hydrostatic pressure, toward points of discharge. The competency of the confining layer and the rigidity of the aquifer are reflected in the low values of the coefficient of storage of Stockton aquifers. Data are not abundant, but preliminary tests indicate that the average coefficient of storage probably is about 0.00001 or 0.00002, a value characteristic of artesian conditions. The coefficient of storage is undoubtably higher in some of the beds of the Stockton, but probably nowhere does it exceed about 0.001.

The Stockton lithofacies has a wide range in permeability, but, considered in its entirety, it probably has the highest average permeability of the consolidated-rock aquifers in Bucks County. Specific-capacity tests for 23 wells that tap the Stockton lithofacies show a range in values from 0.35 to 44 gallons per minute per foot of drawdown and an average specific capacity of 5.95 gallons per minute per foot.

In accord with these hydraulic characteristics of the aquifer, a typical well in the Stockton might have either a relatively large or a moderately small drawdown at a given rate of discharge; but the decline in water level in response to the withdrawal would be translated rapidly throughout the aquifer in the vicinity of the well. Therefore, the proper spacing of wells is especially important for efficient utilization of the ground-water supply, because wells that are too closely spaced may be expected to have appreciable mutual interference, resulting in loss of yield and increased operating and maintenance costs.

The Stockton is the most reliable source of water for industrial and public supply in the upland areas of Bucks County. Records are available for 91 wells that range in yield from 2 gallons per minute to 440 gallons per minute and have an average yield of 78 gallons per minute.

The chemical quality of the ground water from the Stockton cannot be characterized by a single typical analysis. It commonly contains low to

TABLE 5. Analyses of Water From the Stockton Lithofacies
(Parts per million. Numbers correspond to numbers in tables of well data for the counties)

Well No.	Location	Date	Silicia (SiO_2)	Iron (Fe)	Total iron	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Non-carbonate	Specific conductance (at 25° C., micromhos)	pH	Temperature (°F.)
Bk-252	Chalfont Borough, well 8	3-26-53	22	.01	1.2	23	8.6	8.1	1.0	80	24	7.0	.0	13	147	93	27	225	6.9	53
Bk-277	Filter Plant, Doylestown, well #1	7-21-50						24		104	153	6		1.6		202	117	487	6.8	57
Bk-278	Filter Plant, Doylestown, well #2	7-21-50						11		94	26	6		9.2		96	19	237	7.2	54
Bk-279	Filter Plant, Doylestown, well #3	7-21-50						12		111	44	6		8.8		126	35	296	6.9	56
Bk-281	Filter Plant, Doylestown, well #5	7-21-50						15		117	109	4		4.4		185	89	420	7.7	57
Bk-282	Filter Plant, Doylestown, well #6	7-21-50						10		110	49	6		6.1		132	42	302	7.0	55
Bk-283	Cross Keys, Doylestown, well #7	7-21-50						11		49	15	4		11		46	6	135	7.7	55
Bk-284	Doylestown Borough, well #8	3-24-53	18	.04	.66	29	17	8.3	.8	154	19	8.5	.0	5.5	195	142	16	310	7.7	54
Bk-286	Doylestown Ice Co., well #2	4-17-53	15	.04	.04	30	9.9	37	3.5	48	72	54	.0	16	304	116	76	471	6.0	54
Bk-302	Eastern Rotocraft Corp., Doylestown Twp.	4-20-53	17	.03	.06	4.4	1.6	9.6	.7	7	15	5.5	.0	12	80	18	12	95.0	5.2	53
Bk-366	Lacey Park Housing Project, well #1	4-8-53	13	.01	.68	29	16	8.1	.5	115	35	11	.0	15	185	138	44	310	7.2	53
Bk-385	U. Southampton Twp., Municipal Water Authority	4-8-53	28	.01	.48	20	6.2	14	2.2	66	39	9	1.1	1.5	160	75	21	202	6.5	55
Bk-390	Fred J. Bux, well #2, U. Southampton Twp.	9-7-53	10	.09	2.3	12	9.0	13	2.5	39	39	11	.1	10	136	67	35	220	6.5	54
Bk-432	Pine Run Farm Supply Co., Yardley Mill	5-15-53	20	.01	1.1	24	9.4	13	1.7	90	26	10	.1	19	168	99	25	256	6.6	55
Bk-433	Well #2, Yardley	8-23-50						31		102	224	6		3.8		260	176	596	7.5	57
Bk-434	Yardley Water and Power Co., well #3	4-9-53	10	.02	.08	19	4.9	35	2.3	96	37	16	.1	7.8	185	68		286	6.9	51
Bk-435	Well #4, Yardley	8-23-50						36		120	603	8		1.1		660	562	1220	7.5	58
Bk-445	Newtown Artesian Water Co., well #3	4-9-53	20	.03	.25	22	6.7	12	.9	72	34	10	.0	1.2	156	82	23	228	6.3	53

moderate concentrations of dissolved solids and hardness-forming minerals, and is generally low in iron content. Locally the water may be relatively highly mineralized and hard, usually because of larger concentrations of calcium and magnesium associated with sulfate. The origin of the sulfate is not definitely known, but it is probably derived from the mineral glauberite. The Stockton rarely yields water containing objectionable amounts of iron, and in general the water is satisfactory for most uses without treatment.

The temperature of the water ranges from about 53°F to about 57°F, according to the depth of the well. A few higher temperatures have been reported, but these probably result from storage of the water in a standpipe before being sampled, and do not reflect conditions in the aquifer.

Data on the quality of water in the Stockton lithofacies are given in table 3.

Lockatong lithofacies. The Lockatong lithofacies crops out in two wide belts that trend approximately east-west across central and south-central Bucks County, and in a number of narrow bands north of each belt where it interfingers with red beds of the Brunswick lithofacies. (See pl. 1.) In the broad belts of occurrence the Lockatong is generally bounded by the Stockton on the south and the Brunswick on the north, but in some places faults have brought older beds into contact with it. The banded outcrops of the Lockatong are bounded on both north and south by beds of the Brunswick.

Argillite of the Lockatong is a prominent ridgemaker in Bucks County. The courses of the smaller streams are largely controlled by the bedding; hence the outcrop area of broad belts of the Lockatong are characterized by broad ridges that approximately parallel the strike of the argillite beds. Where interbedded with the less resistant shale of the Brunswick lithofacies, the Lockatong tends to form rather distinct ridges.

The boundary between the Lockatong and Stockton lithofacies is commonly marked by a sharp change in topographic slope, and in places by a steep escarpment, the upland level of the argillite of the Lockatong being as much as 200 feet above the terrane of the Stockton.

The Lockatong consists chiefly of dark-gray to black thick-bedded argillite (or mudstone) and occasional zones of thin-bedded black shale. Locally, thin layers of impure limestone or calcareous shale are present. The upper beds of gray argillite are extensively interbedded with dark red argillite. The rocks are evenly bedded and very fine grained; coarse-grained sediments are almost totally lacking except in the lower beds which are transitional with the underlying Stockton lithofacies. Small crystals of calcite and pyrite are numerous in some of the argillite beds and absent from others. Ripple marks are rare, but mud cracks occur almost everywhere throughout the lithofacies.

The Lockatong lithofacies does not exhibit the chaotic interbedding and intergrading of deposits of different textures that is so characteristic of the Stockton lithofacies. Many individual beds or sequences of beds can be traced for considerable distances along the strike. McLaughlin (unpublished manuscript) has used the more persistent strata in subdividing the Lockatong lithofacies into several distinct members which can be recognized to the west in Montgomery County and to the east in New Jersey.

Lockatong Lithofacies

According to McLaughlin (unpublished manuscript), by "Lockatong time" all the sediments deposited in the basin had a common provenance (source) to the north. The Lockatong lithofacies is believed to be contemporaneous with the lower and middle beds of the Brunswick lithofacies, the Lockatong having been deposited in the center of the basin and the Brunswick along the margins. The red beds which occur in the upper part of the Lockatong, and which compose almost all of the contemporaneous Brunswick beds, are the product of a different depositional environment from that which produced the dark-colored argillite of the Lockatong. The sediments of both the Lockatong and the Brunswick were derived from red muds. Most of the Lockatong was deposited under reducing conditions in a lacustrine or swampy habitat, and the red ferric iron was reduced to the black ferrous variety. Occasional beds in the upper part of the Lockatong lithofacies, and virtually all the Brunswick beds, were deposited under fluvial conditions and remained in the red, oxidized, state. Lockatong deposition came to a close when the increasing influx of red sediments engulfed the basin, but in Brunswick time there were brief recurrences of lacustrine conditions which are marked by the occurrence of gray shale with the red beds.

Thus, the history of Lockatong sedimentation paralleled that of Stockton sedimentation in that temporary changes in environment during Lockatong time presaged the permanent change in environment at the end of Lockatong deposition. The change in environment occurred at different times in different parts of the basin. In most places there was no sudden, complete change; instead there were oscillations, both locally and regionally and between lacustrine and fluvial conditions which resulted in the local interbedding of sediments of different color, and in the regional interfingering of the prominent lithofacies.

The thickness of the Lockatong lithofacies varies from place to place. McLaughlin (unpublished manuscript) shows four measured sections, two from each of the broad belts of the Lockatong. In the central belt the thickness along Tohickon Creek and along the Delaware River is over 3,800 feet. In the south-central belt the thickness of the Lockatong ranges from 2,150 feet along the Delaware River to 3,073 feet along Mill Creek. The Lockatong lithofacies apparently is thickest in the central belt.

The Lockatong lithofacies conformably overlies the Stockton lithofacies with only local interfingering of beds. The top of the Lockatong lithofacies is conformable with the overlying Brunswick lithofacies but the contact is transitional and marked by a thick sequence of interbedded red and gray shale. From the center of the basin, which approximately corresponds with the central belt of the Lockatong, the Lockatong lithofacies interfingers with and grades into the Brunswick lithofacies. Northeastward in New Jersey and westward in Berks County, where the Brunswick and Stockton lithofacies are in conformable contact with one another, the Lockatong is entirely absent from the section.

The hydrology of the Lockatong lithofacies is comparable to that of the crystalline rocks. The Lockatong contains both fracture and solution porosity where it has been faulted and jointed and exposed to the forces of weathering. Ground water occurs under water-table conditions in the secondary openings, as far down as the base of the weathered zone.

In general, the Lockatong is inferior to the crystalline rocks as a source of water. The capacity of the Lockatong to store and transmit water is very low. The specific capacities of five wells for which records are available range from 0.10 to 1.88 gallons per minute per foot of drawdown of water level and average 0.90 gallon per foot. Reported yields of 43 wells that tap the Lockatong range from 2 gpm to 25 gpm and average 10 gpm.

The water in the Lockatong characteristically is moderately to highly mineralized and hard, but it is generally free of objectionable quantities of iron. The analyses of two samples given in table 4 are representative of water in the formation having better than average quality. Hall (1934) lists analyses of 7 samples from the Lockatong. The concentration of dissolved solids ranged from 199 ppm to 1,050 ppm and averaged 418 ppm; and hardness ranged from 162 ppm to 533 ppm and averaged 285 ppm. Despite the relatively high mineral content, the water from the Lockatong does not commonly contain objectionable concentrations of any constituents except the hardness-forming minerals. It is used for domestic and stock purposes without treatment, but it is generally softened when used for industrial or public supply.

Table 4. Analyses of Water From the Lockatong Lithofacies

(Parts per million. Numbers correspond to numbers in tables of well data for the counties)

Date of collection	Bk-274 4-27-53	Bk-314 4-22-53
Silica (SiO_2)	11	14
Iron (Fe)	.04	.04
Total iron	.04	.04
Calcium (Ca)	47	28
Magnesium (Mg)	17	15
Sodium (Na)	12	7.0
Potassium (K)	.8	.6
Bicarbonate (HCO_3)	164	120
Sulfate (SO_4)	61	38
Chloride (Cl)	11	7.0
Fluoride (F)	.1	.0
Nitrate (NO_3)	1.4	2.1
Dissolved solids	255	229
Total hardness as $CaCO_3$	187	132
Non-carbonate	53	33
Specific conductance (at 25°C, micromhos)	397	376
pH	7.4	7.4
Temperature	53	53

Bk-274 Bucks County Neshaminy Manor Home
Bk-314 Boy Scouts of America, Camp Ockanickon

Brunswick lithofacies. The Brunswick lithofacies underlies a larger area of Bucks County than any other geologic unit. Its area of outcrop comprises about 200 square miles, or about 36 percent of the total land area of the county, and is about equal to the combined outcrop area of the Stockton and Lockatong lithofacies.

The Brunswick does not crop out in wide belts that cross the county in the manner of the Lockatong and Stockton. Owing to the effects of faulting, intrusion by igneous rocks, and interfingering with the Lockatong, the Brunswick lithofacies has a heterogeneous outcrop pattern. The lower beds of the Brunswick occur in sinuous bands which alternate with

bands of the Lockatong; the upper beds of the Brunswick occur in a patchwork of irregularly shaped exposures commonly surrounded by diabase.

The Brunswick is less resistant to weathering and erosion than either the interbedded Lockatong or the adjacent diabase. It weathers to a gently undulating topography characterized by broad, shallow valleys that trend parallel to the strike of the beds. The continuity of the rolling terrane formed by the Brunswick is interrupted by low ridges formed by shale of the Lockatong and by prominent uplands underlain by diabase.

The Brunswick lithofacies is the most uniform lithologic unit in the Newark group. It is a sequence of monotonously similar, irregularly bedded soft red argillaceous shales locally interbedded with fine-grained red sandstone. The lower beds of the Brunswick in the zone of transition with the Lockatong lithofacies include a considerable thickness of thick-bedded hard red argillite and occasional beds of tough gray shale. The argillite grades upward into typical soft red shale, and near the top of the formation there are rare recurrences of the more resistant Lockatong-type rocks.

The shale of the Brunswick lithofacies does not display a prominent cleavage, but it contains numerous cracks or joints which are commonly inclined at high angles to the plane of the bedding. Ripple marks, mud cracks, and raindrop impressions are abundant through the lithofacies.

Near the northern border of the Triassic basin the Brunswick lithofacies commonly contains beds of fanglomerate interbedded with the red shale. These occur from the bottom to the top of the formation in this area, but they are more numerous and thicker, and contain coarser-grained sediments, in the upper part. A typical occurrence of the fanglomerate is described by McLaughlin (unpublished manuscript) as follows:

> "The transition from red shale and sandstone to fanglomerate is gradual. As a sandstone bed is traced north towards the border, at first a few scattered pebbles appear in it. Farther north the pebbles are more numerous; the bed thickens, and additional banks of conglomerate appear."

The conglomerate consists chiefly of well-rounded quartzite pebbles, but pebbles of limestone and calcareous sandstone are common. In some places calcareous material is so abundant that the rock resembles a limestone breccia.

The Brunswick lithofacies has been extensively intruded by diabase dikes and sills. Near the intrusive bodies the shale has been altered to a hard, dark-colored hornfels that often closely resembles the argillite of the Lockatong. The apparent width of the altered zone, as evidenced in the outcrop, ranges from a few feet to a mile or more, but the true width of the altered rock probably never exceeds a few hundred feet. The Brunswick lithofacies is subdivided (McLaughlin, unpublished manuscript) into several members on the basis of differences in the color and lithology of the sediments. Some of the members can be traced for considerable distances, but others vary irregularly in thickness and are not persistent over an appreciable area. None of the members can be correlated between different areas of occurrence of the Brunswick rocks.

The Brunswick is the thickest of the Triassic lithofacies in Bucks County. Its stratigraphic thickness is about 9,000 feet (McLaughlin, unpublished manuscript), but, as the floor of the basin probably shelves

toward the north, in no one place should the total thickness be present. However, the true vertical thickness probably equals or exceeds 6,000 feet at some places in the county.

The relationship between the Brunswick and the underlying Lockatong is described above in the discussion of the Lockatong lithofacies. In general, the Brunswick lithofacies conformably overlies the Lockatong lithofacies, but the lower beds of the Brunswick extensively interfinger with an appreciable thickness of beds of the Lockatong. The youngest beds of the Brunswick lithofacies have all been eroded away in Bucks County. In the valley of the Delaware River, deposits of Pleistocene and Recent age unconformably overlie the shale.

Eastward into New Jersey and westward into Berks County the Brunswick lithofacies grades along the strike into sandstone and conglomerate. Northward, toward the source of its sediments, the Brunswick thins along the bedding and grades into the border-conglomerate facies. In many places the northern limit of the Newark group is determined by faults, but in some areas the Brunswick overlaps Paleozoic rocks. The marginal faults probably represent local post-depositional movements, not regional movement along the entire northern border of the basin.

The Brunswick lithofacies contains water under both water-table and semiartesian conditions in the weathered zone of the formation, which may extend to depths of 600 feet or more. A water-table aquifer of low permeability, comprising the highly weathered zone of the formation, occurs to depths of about 250 feet; and one or more rather permeable artesian aquifers, consisting of beds of partly altered rock rarely more than 20 feet thick, occur to depths of about 600 feet. In both types of aquifers the saturated voids are believed to be vertical joint fractures enlarged by solution. The water-table aquifer contains many more fractures than the semiartesian aquifers but the near-surface rocks have been so thoroughly decomposed that many of the cracks are filled with clay residual from the weathering of the shale.

The water-table aquifer is recharged from precipitation, a part of which seeps through the soil mantle to the water table. The underlying seimiconfined aquifers are, in turn, recharged by drainage from the water-table zone; thus the total supply of water in storage is essentially that in water-table storage.

Most wells in the Brunswick lithofacies tap both water-table and artesian aquifers, and their yields are derived in part from both sources. Consequently, coefficients of transmissibility and storage determined by analysis of field pumping tests are meaningless, as they represent combined effects of withdrawals from aquifers of different types. Because the semiartesian aquifers are more permeable than the water-table aquifer and yield much less water from storage, the artesian pressure tends to decline rapidly with pumping and there results a hydraulic gradient downward from the water-table to the artesian zone. A typical well may have a relatively high yield when drilled, but the yield declines as the water-table aquifer in the immediate vicinity is unwatered. The ultimate yield of a well is related to the saturated thickness of water-table aquifer it penetrates, and the rate at which the semiartesian aquifers

TABLE 5. Analyses of Water from the Brunswick Lithofacies

(Parts per million. Numbers correspond to numbers in tables of well data for the counties)

Well No.	Location	Date	Silicia (SiO_2)	Iron (Fe)	Total iron	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Non-carbonate	Specific conductance (at 25°C, micromhos)	pH	Temperature (°F.)
Bk-50	Richlandtown Borough, well 2	3-26-53	20	.01	1.8	38	19	14	1.0	------	157	59	8.5	.1	5.5	263	173	44	363	7.4	52
Bk-62	Quakertown Borough, well 9	3-25-53	22	.01	1.3	77	18	13	1.0	------	164	144	7.0	.3	2.8	381	266	132	555	7.7	52
Bk-94	Trumbauresville, well 2	3-26-53	14	.02	.18	44	21	16	1.2	------	184	64	8.0	.1	.8	272	196	45	425	7.7	52
Bk-138	Sellersville Borough, well 2	4-8-53	13	.02	.56	71	26	16	.9	------	226	107	12	.1	5.5	386	284	99	594	7.5	54
Bk-143	Perkasie Water Supply Co., well 4	4-7-53	------	.02	.19	------	------	14		------	212	30	6	------	.8	------	184	10	401	7.4	53
Bk-144	Perkasie Water Supply Co., well 5	4-7-53	19	.01	1.1	37	16	13	1.8	------	172	31	10	.1	1.8	217	158	17	358	7.4	53
Bk-157	Freed Glass Works, 5th & Vine Sts., Perkasie	7-31-46	21	.05	------	54	22	13	1.6	------	237	32	12	.1	6.4	272	225	------	462	7.4	51
Bk-330	Universal Paper Bag Co., New Hope	9-8-53	17	.06	.04	49	14	26	.6	------	156	53	22	.1	21	311	180	52	487	7.7	56
Bk-331	Union Mills Paper Manufacturing Co., New Hope	9-15-53	20	.10	.05	15	3.8	76	.2	26	73	112	12	.4	.4	355	53	------	509	8.9	55
Bk-342	Van Pelt & Co., Pineville	9-8-53	10	.08	.14	42	15	9	.6	.0	137	41	13	.1	5.1	239	166	54	380	7.8	53

it taps are recharged from above. The history of drilled wells shows that the long-term yield of a well is commonly no more than about one-third of the initial yield.

The Brunswick is an important source of water for domestic, industrial, and public supply in Bucks County. It underlies more than one-third of the total land area of the county, and is everywhere a reliable source of moderate supply. The reported yields of 52 wells for which records are available range from 2 gpm to 260 gpm and average 40 gpm.

The water from the Brunswick is moderately mineralized and moderately hard to hard, but it does not contain objectionable amounts of any constituents. Its iron content is negligible; some samples contain relatively large amounts of sulfate, perhaps from local solution of the mineral glauberite, which has been noted in the rock, but the concentration is not excessive.

The water is of satisfactory quality for most uses without treatment. It is acceptable for public supply according to the suggested standards of the United States Public Health Service. Except for the silica content, which is too high for use of the raw water in high-pressure steam boilers, it is satisfactory for most industrial purposes. The temperature is nearly constant and ranges, in individual wells, from about 50°F in shallow wells (50-150 feet deep) to about 55°F in deep wells (more than 400 feet deep).

Chemical analyses of representative samples of water from the Brunswick lithofacies are given in table 5.

Geology of the Unconsolidated Rocks

Unconsolidated rocks of Late Cretaceous, Pleistocene, and Recent age occur in Bucks County. The Pleistocene and Recent sediments occur as terrace remnants and valley-fill deposits in the major stream valleys. Cretaceous beds do not crop out in Bucks County, but they underlie Quaternary deposits in the broad valley of the Delaware River between Morrisville and Andalusia.

In this report the discussion of the unconsolidated rocks is confined to the Coastal Plain sediments of southeastern Bucks County. In the Piedmont region unconsolidated rocks occur only as a thin veneer on the bedrock floor. Their only function in the regimen of ground water occurrence is to trap precipitation and thus to facilitate recharge to the underlying rocks. A detailed description of these deposits and of the Pleistocene history of Bucks County is given by Peltier (unpublished manuscript).

Coastal Plain sediments underlie an area of about 34 square miles in southeastern Bucks County in the valley of the Delaware River southeast of the Fall Line. The deposits range in thickness from a featheredge at the Fall Line to about 200 feet or more at the extreme southeastern boundary of the county. The unconsolidated rock formations that compose the Coastal Plain sediments in Bucks County include, in ascending order, the Raritan formation of Late Cretaceous age, glacial outwash of Pleistocene (probably late Wisconsin) age, and alluvium of Recent age. Following are descriptions of the individual rock units.

Cretaceous System

Raritan formation. The Raritan formation was named for exposures of alternating beds of clay and sand in the Raritan Valley in Middlesex County. In that area the formation has been subdivided on lithologic grounds into several distinct members, but it has not been possible to trace the individual members south of the type area to the Delaware River valley. Similarly, in the Raritan Valley the formation is readily differentiated on the basis of faunal and lithologic evidence from the overlying Magothy formation, which also is of Late Cretaceous age. The two formations are indistinguishable in the Delaware River Valley and are commonly mapped as a single unit. In this report the Magothy and Raritan formations are undiffentiated, and all Upper Cretaceous deposits in the area are considered to be the Raritan formation.

The Raritan formation is composed of alternating beds of clay and sand, or gravel. The clay ranges in color from white or cream through light gray to dark gray and brick red. The composition varies from sandy and lignitic clay, which commonly contains nodules of iron sulfide, to even-textured, white-burning, highly refractory clay. The sand and gravel of the Raritan is characteristically light colored, chiefly white or light gray, but yellow- or red-colored beds, in which the color is due to the presence of small quantities of iron oxide, are not uncommon. The clastic sediments range in shape and texture from subangular to angular coarse sand and gravel to well-rounded medium- and fine-grained sand. The coarse materials predominate, but the deposits are poorly sorted and many are mixtures of sand, gravel, and clay.

The individual beds of the Raritan formation show little areal continuity. The deposits are apparently lenticular in shape, and in general it is difficult to correlate beds from one borehole to another, even where the holes are closely spaced. In Bucks County the Raritan formation consists of nonmarine beds, but marine fossils have been found in at least one clay member in the Raritan Valley. The beds apparently were laid down in an estuarine environment which was subject to relatively abrupt changes in the conditions of sedimentation due to oscillations of sea level.

The Raritan formation occupies the interval between the crystalline-rock floor and the overlying Pleistocene materials. The beds dip toward the southeast at an average rate of about 60 feet to the mile, which is about equal to, but slightly less than, the slope of the bedrock floor. In Bucks County, the upper surface of the Raritan formation is not a dip surface—rather, it is the beveled edge of the tilted strata. Consequently it does not exhibit the regional dip of the formation; instead, the highest points on the surface occur at a relatively uniform altitude throughout the area.

The Raritan formation ranges in thickness from a thin veneer on the crystalline bedrock at the Fall Line to 150 feet or more at the extreme southeast corner of the county, where the Delaware River makes a sharp bend to the southeast. The thickness of the formation varies considerably from place to place, even along the strike of the beds. The variation may be attributed to the pre-Raritan and post-Raritan erosional history.

The bedrock floor on which basal sediments of the Raritan were deposited presented an irregular surface which permitted greater accumulations of sediments in some areas than in others. Similarly, the upper surface of the Raritan formation was made uneven by the scouring of the ancestral Delaware River during Pleistocene time. In general the beds tend to thicken in a down-dip direction. However, as the configurations in the upper and lower surfaces of the formation are unrelated, and are not oriented in any recognized pattern, it is not possible to predict with accuracy the thickness at a given location by interpolation between points of known thickness.

The Raritan formation is in unconformable contact with both the underlying crystalline rocks of Precambrian age and the overlying valley-fill sediments of Pleistocene age. Neither contact is exposed in Bucks County, but they have been penetrated by boreholes in many places.

The lower contact is readily recognized in drill cuttings. The Raritan formation is underlain by decomposed schist which is identified by the abundance of mica in the formation samples. The top of the Raritan formation is not so well defined. The upper contact is commonly drawn at the top of the first conspicuous fine-grained bed that occurs below the typical coarse-grained Pleistocene beds. Where the hard, dense clay of the Raritan occurs the contact is well marked, but in many places sand and gravel of the Raritan immediately underlie Pleistocene beds and the contact is obscure.

Quaternary Deposits

Valley-fill sediments of Quaternary age overlie the Raritan formation in the Coastal Plain area of Bucks County. They consist of glacial outwash of Pleistocene (Wisconsin) age and alluvium of Recent age which were deposited in the scour channel of the ancestral Delaware River. The Pleistocene deposits constitute nearly all the valley-fill; Recent alluvium comprises only the thin surficial flood-plain deposits. As the Pleistocene and Recent deposits are lithologically and hydrologically indistinguishable, they are described as a single geologic unit in this report.

The valley fill consists chiefly of stream-laid deposits of brown to gray coarse sand and gravel and subordinate amounts of clay, silt, and fine- to medium-grained sand. It is a mixture of coarse-textured sediments of local origin and fine-textured sediments of remote origin which were transported to the area by glacial melt waters. Most of the material is poorly sorted, but some even-textured deposits, principally of fine grain are found.

The lithology of the glacial outwash varies greatly from place to place. The deposits are erratically interbedded and there is no recognizable pattern or sequence of deposition, except that the materials commonly are coarser textured with depth. There is no well-defined horizon that is persistent throughout the area, and, in general, individual beds cannot be correlated, even between closely spaced wells.

The valley fill ranges in thickness from a featheredge at the Fall Line to 80 feet or more in the deep parts of the buried channel. The thickness varies also with irregularities in the Cretaceous erosional surface described in the previous section.

Water-Bearing Characteristics

Water-Bearing Characteristics of the Unconsolidated Rocks

The unconsolidated sediments contain ground water under both water-table and artesian conditions. The water-table aquifer comprises the valley fill deposits of Recent and Pleistocene age; artesian conditions occur in the underlying Cretaceous sediments where beds of sand or gravel lie beneath the dense clay bed that marks the top of the Raritan formation. Locally the confining bed may be absent, and in these places water-table conditions prevail to the base of the unconsolidated deposits.

The unconsolidated-rock aquifers are favorably situated with respect to recharge. Under virgin conditions the natural slope of the hydraulic gradient was riverward, and essentially all recharge to the water-table aquifer was derived from local precipitation or from subsurface drainage from the upland Piedmont region that lies to the northwest. These remain the chief sources of recharge, but, with development of the area, an added increment of recharge has been derived as induced infiltration from the adjacent river. Induced infiltration exists where there is local reversal of the initial slope of the hydraulic gradient in response to large withdrawals from wells. The artesian aquifers are insulated from the river, and they do not crop out along the valley; but they are recharged, as in the past, by upward movement of water through the crystalline rocks, and by downward percolation from the water-table aquifer.

The unconsolidated rocks are the sources of the largest and the most reliable ground-water supplies in Bucks County. The aquifers are highly permeable and those under water-table conditions have a high coefficient of storage. The coefficient of storage of the water-table aquifer probably ranges from about 0.05 to 0.30 or more. The coefficients of storage of the artesian aquifers probably range from about 0.0001 to 0.001, but the area of influence resulting from local withdrawals does not extend far from a typical well because of the discontinuous nature of the confining bed, which permits local recharge from the overlying water-table aquifer.

The specific capacities of 19 wells for which test records are available range from 3.33 gallons per minute per foot of drawdown to 44 gallons per minute per foot and average 23 gallons per minute per foot. The reported yields of 43 wells that tap the unconsolidated sediments range from 10 gpm to 1,050 gpm and average 304 gpm.

The water in the unconsolidated rocks commonly has a low concentration of dissolved solids, is generally soft, and is moderately acidic in reaction. The only mineral constituents present in objectionable quantities are iron, which is a problem in relatively few well-water supplies, and nitrate, which is high in a few wells. The occurrence of water of high iron content is erratic and unpredictable, but the iron is believed to be derived largely from zones in the glacial outwash in the water-table aquifer. However, artesian water supplies have been contaminated locally as a result of leakage from the water-table aquifer induced by pumping. Except for the supplies that contain excessive amounts of iron, ground water from the unconsolidated deposits can be used for almost any purpose without treatment.

Supplies in the water-table aquifer that are in part recharged by infiltration from the Delaware River show a progressive change in quality

TABLE 6. Analyses of Water From Unconsolidated Rocks

(Parts per million. Numbers correspond to numbers in tables of well data for the counties)

Well No.		Date	Silicia (SiO_2)	Iron (Fe)	Total iron	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Manganese (Mn)	Dissolved solids	Total hardness as $CaCO_3$	Non-carbonate	Specific conductance (at 25°C, micromhos)	pH	Temperature
Bk-424	John Barlow, Upper Makefield Twp.	4-30-53	14	.07	4.4	26	7.1	6.0	1.0	3	66	25	10	.0	4.8	------	145	94	35	226	6.4	54
Bk-479	Margold Ribbon Mills, Andalusia ---	1-21-54	20	.07	.14	6.4	5.7	4.2	1.3	------	18	26	5.0	.1	2.2	------	85	39	25	101	6.3	54
Bk-499	Publicker Industries Inc., Eddington	1-21-54	8.2	.03	.30	16	8.0	21	2.2	------	38	59	19	0.4	11	------	205	73	42	309	6.5	55
Bk-508	Eppinger & Russell Co., well #3, Eddington ------------------------	4-28-5	20	.01	7.2	41	12	33	4.5	------	122	89	25	.2	.5	------	303	152	52	457	5.9	56
Bk-531	Bath Wells, well #1, Bristol --------	8-16-50	------	------	------	------	------	3.4		------	14	29	8	------	3.0	------	------	48	37	157	5.9	57
Bk-532	Bath Wells, well #2, Bristol --------	8-16-50	------	------	------	------	------	4.3		------	11	16	6	------	14	------	------	36	27	125	5.8	58
Bk-533	Bath Wells, well #3, Bristol --------	8-16-50	------	------	------	------	------	5.7		14	29	14	10	------	2.0	------	------	65	18	174	9.3	56
Bk-534	Bristol Borough, well 4, (Bath well field) ------------------------------	4-15-53	9.6	.04	.04	4.1	3.4	5.0	1.7	.0	9	15	7.5	.0	5.4	------	63	24	17	87.1	5.5	54
Bk-535	Bath Wells, well #5, Bristol --------	8-16-50	------	------	------	------	------	5.5		.0	7	5.8	8	------	8.6	------	------	18	12	87.4	5.5	58
Bk-537	Bath Wells, well #7, Bristol --------	8-16-50	------	------	------	------	------	7.0		.0	12	14	8	------	18	------	------	35	25	134	5.6	58
Bk-538	Bath Wells, well #8, Bristol --------	8-16-50	------	------	------	------	------	1.2		.0	10	4.9	3	------	8.6	------	------	22	14	82.4	6.2	56
Bk-551	Atlantic Ice Co., Bristol ------------	9-17-46	13	.01	------	11	13	13	3.4	.0	19	48	20	.0	34	.00	163	81	------	260	6.0	56
Bk-562 Bk-563	Bristol Borough Wells 1 and 2 (Edgely field) ----------------------	4-15-53	6.7	.03	.50	13	9.4	5.0	2.2	------	15	49	10	.0	11	-----	127	71	59	195	5.8	51

Bk-595	Lower Bucks Co., Joint Mun. Auth., Water Dept., well 5 (Levittown well field adjacent to Del. River)	4-15-53	5.1	.03	.04	12	6.2	8.3	1.1	-----	50	22	5.0	.1	4.0	-----	95	55	14	139	6.3	47
Bk-629	Victor Chemical Co., Falls Twp.	1-20-54	12	.06	2.1	22	10	3.3	1.0	-----	59	32	10	.1	3.9	-----	125	96	48	212	6.7	56
Bk-634	King Farm, Inc., well #2, between Bristol and Morrisville	9-17-46	12	.04	-----	7.9	3.9	3.1	1.3	-----	24	5.2	5.1	.1	12	.0	68	36	-----	91.5	6.7	55
Bk-636	King Farm, South of Morrisville well #4	5-25-50	12	.03	-----	9.4	4.4	4.8	.9	-----	24	20	5.2	.1	5.8	.0	77	42	22	118	6.5	56
Bk-638	Pennsbury Manor, Falls Twp.	1-20-54	7.0	.06	.72	20	9.7	3.9	2.0	-----	50	34	11	.2	4.8	-----	126	90	49	217	6.7	60
Bk-639	Starkey Farms Co., Well #: Starkey Stinson #1, 3.4 miles E. of Tullytown	6-13-50	7.4	.13	.19	34	19	8.5	3.4	-----	71	74	21	.0	20	.00	231	163	105	387	6.7	55
Bk-640	Starkey Farms Co., Starkey-Mershon #1, 3.1 miles E. of Tullytown	6-13-50	6.1	.10	.84	29	17	11	2.1	-----	36	87	20	.2	33	.00	244	142	113	388	6.5	54
Bk-641	Starkey Farms Co., Starkey-Allen #1, 3.8 miles E. of Tullytown	6-13-50	9.2	.06	.08	32	14	10	2.6	-----	32	92	16	.0	23	.00	225	137	111	353	6.2	53
Bk-642	Starkey Farms Co., Starkey-Berry #1, 3.8 miles E. of Tullytown	6-13-50	9.9	.40	.43	57	43	76	12	-----	53	189	122	.0	107	.00	716	319	276	1090	6.3	53
Bk-643	Starkey Farms Co., Starkey-Hollywood #1, 4.1 miles E. of Tully town)	6-13-50	14	.11	2.0	8.2	7.6	11	1.8	-----	8	45	17	.1	1.2	.43	115	52	45	183	5.2	53
Bk-644	Starkey Farms Co., Starkey-Wilcox #1, 4.8 miles E. of Tullytown	6-13-50	7.0	.13	.27	28	22	61	12	-----	123	115	34	.0	52	.00	398	160	60	645	6.5	53
Bk-645	Starkey Farms, S. of Morrisville, well #1	5-25-50	7.4	.06	-----	47	25	5.9	3.4	-----	60	113	24	.1	42	.0	334	220	171	503	6.4	56

toward that of the river, until equilibrium is reached between the sources of recharge. Some improvement in the quality of the ground water results from this because the river water commonly has a lower concentration of dissolved constituents. Such conditions are not widespread at the present time, but with continued development of the area induced infiltration will become an important factor in maintaining the high yields and excellent quality of ground water from the unconsolidated deposits, so long as the river water remains of good quality.

The temperature of the ground water in the unconsolidated deposits ranges from about 53°F to 55°F except where influenced by artificial factors or by recharge from nearby streams. The effect of river infiltration is to increase the range of fluctuation of the temperature of ground water. The temperature fluctuation of the ground water follows a cycle that is similar to, but has less amplitude, than that of the river water. It generally lags several weeks to several months behind that of the river. The temperature of water from wells that tap unconsolidated deposits in Bucks County is reported to fluctuate through a maximum annual range of 15°F, from 47°F to 62°F.

Data on the quality of water in the unconsolidated deposits are given in table 6.

WITHDRAWALS FROM WELLS

The average daily use of ground water in Bucks County was about 25.5 million gallons per day in 1953. Withdrawals for industrial use accounted for about 12 million gallons a day, most of which was pumped from the unconsolidated deposits in the southeastern part of the county. Withdrawals for private supplies for domestic, stock, and other nonindustrial purposes amounted to about 4.5 million gallons, most of which was obtained from consolidated-rock aquifers.

Public supply	*Population served*	*Average daily pumpage (mgd)*	*Geologic source*
Bristol	25,000	3.5	Unconsolidated deposits
Chalfont	830	.07	Lockatong lithofacies
Cornwells Heights		.02	Wissahickon schist
Doylestown	5,500	.44	Stockton lithofacies
Falls Township		1.0	Unconsolidated deposits
Lacey Park	6,000	.20	Stockton lithofacies
Langhorne	6.500	.48	Baltimore gneiss
Newtown	2,500	.24	Stockton lithofacies
Parkland	860	.04	Chickies quartzite Baltimore gneiss
Perkasie	4,400	.20	Brunswick lithofacies
Quakertown	6,000	.36	Brunswick lithofacies
Richlandtown	760	.01	Unconsolidated deposits
Rieglesville	900	.15	Byram granite gneiss
Sellersville	2,300	.03	Brunswick lithofacies
Springtown	110	.02	Byram granite gneiss
Telford	2,300	.12	Brunswick lithofacies
Trumbauersville	176	.02	Brunswick lithofacies
Tullytown	11,300	1.68	Unconsolidated deposits
Upper Southampton	1,680	.07	Stockton lithofacies
Yardley	5,750	.33	Stockton lithofacies

Availability

Withdrawals for public supply averaged about 9 million gallons a day This quantity was pumped by 21 water companies serving about 83,000 people. Public water-supply systems in Bucks County that use ground water are listed in the following table, which includes data on population served, average daily pumpage, and geologic source of the supply.

WATER-LEVEL FLUCTUATIONS

Ground-water levels seldom remain stationary; they rise and fall with changes in the amount of water stored in the subsurface reservoirs. These fluctuations may reflect both natural and man-made changes in the rates of discharge and replenishment. The man-made effect of diversion of ground water is locally superimposed upon natural fluctuations which occur in response to seasonal variations in precipitation, evaporation, and transpiration, or variations in river levels or barometric pressure.

In the consolidated-rock aquifers of Bucks County ground-water levels are most affected by variations in recharge, which in turn are related to rates of evapotranspiration. Other factors vary only slightly; precipitation is fairly evenly distributed throughout the year, and recharge from streams, or withdrawals by man, are of only local significance. Ground-water levels are highest in early spring, after the period of maximum recharge and of minimum loss of water by evapotranspiration. They are lowest in early fall, at the end of the growing season, after a protracted period of high evapotranspiration, virtually no recharge, and continued natural drainage of ground water into streams.

In the unconsolidated deposits adjacent to the Delaware River in southeastern Bucks County, ground-water levels are affected chiefly by evapotranspiration, withdrawals from wells, and tidal fluctuations of river level. Seasonal fluctuations are not so pronounced as in the consolidated rocks of the upland areas because the river, which is a tidewater stream, has a relatively constant mean stage and subdues the annual cyclic trend by providing recharge to the unconsolidated-rock aquifers. However, wells located close to the river may show relatively large diurnal fluctuations of water level in response to the 6-foot tidal fluctuation in the river.

A graph of the average monthly precipitation computed for two stations in Bucks County for the period May 1953 to February 1955 is shown on plate 2 with hydrographs for five wells in the county. The precipitation is graphed as the average recorded at United States Weather Bureau stations at George School and Quakertown. The hydrographs showing water levels in wells are representative of four different geologic formations, as follows: Bk-666—Wissahickon schist; Bk-295 and Bk-372—Stockton lithofacies; Bk-147—Brunswick lithofacies; and Bk-628—unconsolidated sediments. Well Bk-666 is not shown on the well-location map (pl. 1); however, its location may be determined from its well-location number. It is situated approximately 0.2 mile northeast of well Bk-481 in the vicinity of Andalusia, in the extreme southwestern part of the county. The graphs show that precipitation has little immediate effect upon ground-water levels; and also that there has been no regional decline of water level during the period of record, despite the increased demands for ground water in recent years.

AVAILABILITY OF ADDITIONAL SUPPLIES

It is impossible to estimate the potential ground-water supply available in any selected locality in Bucks County because of the inadequacy of hydrologic data. However, it is certain that the rate of withdrawal of ground water can be increased greatly in all parts of the county without depletion of the supply. In some localities large additional withdrawal might impose a local overdraft on the aquifer if new wells are installed too close to existing well fields.

The most promising sources of additional supply are the unconsolidated deposits adjacent to the Delaware River. The rate of withdrawal can be increased many times without serious depletion of supplies, and the quality of water will be improved if new developments are designed to induce recharge from the river.

Moderate additional supplies can also be obtained from the consolidated-rock aquifers, but they are wholly dependent upon natural local recharge for replenishment. Consequently they are not as susceptible to management as the unconsolidated-rock aquifers.

The future development of ground-water supplies from all sources will be influenced by advances in drilling and well-maintenance techniques. An important limiting factor in the yield of any ground-water development is the hydraulic efficiency of wells. Through the years, yields of wells have been appreciably increased by improved methods of construction, development, and maintenance, and this trend may be expected to continue. However, expansion of ground-water use will ultimately depend upon the ability of aquifers to store and transmit water in quantities equivalent to withdrawals.

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APPENDIX

During the field investigations, data were obtained for more than 650 wells in Bucks County. The location of the wells is shown on plate 1, and the data are presented in the following table.

The table is self explanatory except for column 2, location number. The location numbers show the location of wells according to an arbitrary grid pattern devised by the Pennsylvania State Planning Board. Each location number consists of a series of letters and numbers that define the northwest corner of a square area, one-tenth mile on a side, within which the well is located. On the side and top margins of the well-location map, plate 1, are respectively capital letters G through J (omitting I) and consecutive numbers 22 through 25. Each letter-number combination defines an area (or quadrangle) 15 minutes of latitude and 15 minutes of longitude on a side. For example, Morrisville is in J24. In the location-numbering system the capital letter and number are followed by a lower case "a", "b", "c", or "d" corresponding to the northwest, northeast, southwest, or southeast quarter of the 15-minute quadrangle, and the location number then represent a 7½-minute quadrangle. The remaining part of the location number consists of a hyphen and a 4-digit number. The first pair of digits represent a distance in tenths of mile south from the north border of the 7½-minute quadrangle defined by the first half of the location number. The second pair represents a distance east from the west border. The point defined by these distances is the northwest corner of the square area (0.1 mile on a side) in which the well is located.

Records of Wells

Numbers correspond with those on plate 1.
Type of well: Drl, drilled; Drn, driven.
Use of water: D, domestic; E, emergency; I, industrial; Irr, irrigating; PS, public supply; S, stock; T, testing; U, unused; X, destroyed.
Chemical Analyses: C, complete; P, partial.

Aquifer: Cc, Conococheague limestone; Cch, Chickies quartzite; Ce, Elbrook limestone; Ch, Hardystone quartzite; Cl, Cambrian limestone; gn, gneiss; Ob, Beekmantown limestone; Oc, Cocalico phyllite; Trb, Brunswick lithofacies; Trd, Diabase; Trl, Lockatong lithofacies; Trs, Stockton lithofacies; unc, unconsolidated deposits of Cretaceous and Quaternary age; ws, Wissahickon schist.

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
1	G23c-1422	Clymer Springs Water Co.		12/49	270	Drl	8	127		Ch	9	12-8-52	35	PS	
2	G23c-3026a	Durham Paper Board Co.		1932	150	Drl	8	95	19c	Cl	21	1946	600	I	
3	G23c-3026b	Durham Paper Board Co.		1932	150	Drl	8	95		Cl	77	1946	600	I	
4	G23c-3025	Durham Paper Board Co.	M. Biery	1951	160	Drl	12	317		Cl	34	12-9-53	750	U	
5	G23c-3620	Pagliaro Bros. Chevrolet Co.	H. Knierium	1950	160	Drl	6	93	90c	Trb	20	1950		D	
6	G23c-3522	Joseph Pavlica, Jr.	H. Knierium	1951	330	Drl	6			Ch				D	
7	G23c-3111	Durham School			235	Drl	6	134		Cl	34	1942			
8	G23c-3313b	Riegel Feed & Grain Co.		1949	160	Drl	6	90	85c	Cl	30	1949		S	
9	G23c-3313a	Floyd Riegel		1947	195	Drl	6	85	80c	Cl	30	1947		D	
10	G23c-4616	Eugene Kirkpatrick	R. J. Collins	4/52	420	Drl	6	72		Trb	12	4/52		D	
11	G23c-4200	George Gachenbach	R. J. Collins	1950	270	Drl	6	127	107c	Cl	42	1950		D	
12	G22d-4564	Lester O. Bodder		1937	320	Drl	6	225	60c	Ch				D,S	
13	G22d-4857	George R. Hooper			400	Drl	6	80		Ch				D	
14	G23c-5104	Frank DeSilver			550	Drl	6	110		Trb	6	1949		D	
15	G23c-5807	J. M. Lange		1946	700	Drl	6	60		Trb					
16	G23c-6105b	Lewis Freeh	H. Knicrium	1950	605	Drl	6	100		Trl	2	1950			
17	G23c-6105a	Anthony Schulberger			610	Dug	48	27	27c	Trl				D	
18	G23c-6802	Henry Makl, Jr.	H. Knierium	1950	570	Drl	6	105	21c	Trb				D	
19	G22d-6863	Paul Boer			600	Dug	72	28	28c	Trd				D	
20	G22d-7062a	Paul Boer	Boer & Others	1937	595	Dug	60	8	8c	Trd				D	
21	G22d-7062b	Paul Boer	Boer & Others	1946	590	Dug	108	17	17c	Trd				D	
22	G22d-5536	Marvin Quier	R. J. Collins	1948	475	Drl	6	42	12c	Trb					
23	G22d-5637	Leroy Fluck	R. J. Collins	12/52	460	Drl	6	39		Trb	4	1/53			
24	G22d-6339	Dr. W. A. Finady	W. Shaw	1950	515	Drl	8			Trb				D	
25	G22d-7043	Springfield High School	M. Biery	1945	470	Drl	8	300±	50c	Trb			50	PS	
26	G22d-7142	C. Fritz	Kohl Bros.	1940	460	Drl	6	200	86c	Trb				I	
27	G22d-6937	Oliver W. Holton	R. J. Collins	1948	530	Drl	6	185	20c	Trb				D	
28	G22d-5927	Frank S. Harkin			720	Drl	6	87		Trb	8.3	1-30-53		D	
29	G22d-6821	Arthur Ebert		1939	840	Drl	6	84	40c	Trb				D	
30	G22d-0023	Adam Vorndran		1947	650	Drl	6	185		Trb	38	1939		D	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/ or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
31	G22d-4709	Boro of Coopersburg	M. B. Biery	1936	660	Drl	8	200	50c	Trb			150	PS	
32	H22a-0663a	Victor Berger Sr.	W. Wonsidler		620	Dug	48	33		Trd	5.1	12-1-52		D	
33	H22a-0663b	Victor Berger Sr.	W. Wonsidler	10/52	620	Drl	6	92	15c	Trd	6	11/52		D	
34	H22a-0853a	Lob & Fenessy			680	Drl	6	198		Trb					
35	H22a-0853b	Lob & Fenessy	R. J. Collins	8/49	675	Drl	6	119		Trb			20	D,S	
36	H22a-1055	R. B. Harwick & Sons	C. S. Barber	1952	670	Drl	8	148	18c	Trb				D	
37	H22b-1100a	Berlenbach Foundry Co.			560	Dug	48	15		Trd				I	
38	H22b-1100b	Berlenbach Foundry Co.		1949	560	Dug	48	16		Trd	2.4	12-12-52		E	
39	H22b-1901a	Hubert Benetz		1935	560	Drl	6	96		Trd					
40	H22b-1901b	Hubert Benetz	R. J. Collins	1951	560	Drl	6	120	27c	Trd	10	1951			
41	H22b-2001b	Hubert Benetz	C. S. Garber & Sons	1/53	580	Drl	6	510	27c	Trd	6.2	5-12-54		U	
42	H22b-2001a	Kaufman School		1911	600	Drl		39		Trd				U	
43	H22b-2804	Samphson Hosiery Mill			560	Dug	54	8.5	8.5c	Trb	4.9	12-1-52		I	
44	H22b-3015	Quakertown Brick & Tile Inc.	W. Shaw	1945	510	Drl	6	60	60c	Trb	20	1945		I	
45	H22b-1912	California School		1911	560	Drl		52		Trd					
46	H22b-1514a	Frank Loew		1900	520	Dug	42	11	11c	Trd	2.6	12-12-52		S	
47	H22b-1514b	Frank Loew		1900	515	Dug	48	14	14c	Trd	10	9/52		D	
48	H22b-1531	Wimmers School		1911	525	Drl		99		Trb					
49	H22b-2130	Richlandtown Boro	J.W. Shaw	12-1-35	515	Drl	14-10	300	30c	Trb	10	6-16-36	110	PS	
50	H22b-2030	Richlandtown Boro	J.W. Shaw	3/46	515	Drl	14-10	243	21c	Trb	9	3-27-46		PS	C
51	H22b-1928	R.Q.L. Shirt Co.	J. W. Shaw	1938	530	Drl	6	120		Trb				I	
52	H22b-2029a	Mrs. Ida Bleam			515	Dug	48	25		Trb	15.3	3-27-46		D	
53	H22b-2029b	Mrs. Ida Bleam	J. W. Shaw	1935	515	Drl	6	101		Trb	3	1935		D	
54	H22b-2417a	Quakertown Boro			495	Drl				Trb	5.0	1-20-53			
55	H22b-2416b	Quakertown Boro			495									U	
56	H22b-2416c	Quakertown Boro			495									U	
57	H22b-2416a	Quakertown Boro			500	Drl	12-8	215		Trb	40	1946		U	
58	H22b-2416b	Quakertown Boro			500	Drl	12-10	310	20c	Trb			125	PS	
59	H22b-2416c	Quakertown Boro			500	Drl	10	200	20c	Trb			120	PS	
60	H22b-2416d	Quakertown Boro			500	Drl	10	200	20c	Trb			120	PS	
61	H22b-2415a	Quakertown Boro	M. B. Biery		495	Drl	16-10-8	302	55.5c	Trb			33	PS	
62	H22b-2415	Quakertown Boro	Ridpath & Potter	10/46	490	Drl	8	300	248c	Trb				U	C
63	H22b-3321	Quakertown Boro	F.L.Bollinger	3/51	500	Drl	16-10	230	56.5	Trb	8	4/51		PS	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
64	H22b-3621	Mrs. Bertha Hering	W. Shaw	1937	505	Drl	6	38	38c	Trb	15	1937		D	
65	H22b-3819a	Quakertown Power Plant	J. W. Shaw	1920	500	Drl	8	108		Trb	23	3-26-46		I	
66	H22b-3819b	Quakertown Power Plant	J. W. Shaw	1940	500	Drl	8			Trb				I	
67	H22b-3819	Hajoca Corporation	W. Shaw	1948	495	Drl	8-6	164	132c	Trb	40	11-18-52		I	
68	H22b-3919	Panco Cigar Co.			495		6	75		Trb			60	U	
69	H22b-4019	Community Improvement Co.			495		6	125		Trb			25+	U	
70	H22b-3920	Quakertown Ice & Storage	J. W. Shaw	1936	495	Drl	8	200		Trb	73	12-29-52	100	I	
71	H22b-4018	Jacob Underhoffel	Collins	1947	495	Drl	8	38	10"c	Trb					
72	H22b-4222	Murlin Manufacturing Co.	W. M. Emert	1926	500	Drl	8	365		Trb			70	I	
73	H22b-4221	Quakertown Laundry	W. Shaw	1937	505	Drl	6			Trb	8-10	1937		I	
74	H22b-4013	Quakertown Clothing Mfg. Co.			510	Dug	60	32	32c	Trb	5.5	11-28-52		I	
75	H22b-4112	Quaker Safety Products			520	Drl	6			Trb				I	
76	H22b-3910	Quakertown Webbing Co.	J. W. Shaw		510	Drl	6	57		Trb			10	I	
77	H22b-3810	Thermco Products Corp.		1940	510	Drl	8	150	30c	Trb				I	
78	H22b-3712	Willauer Machine Co.	W. Shaw	1926	510	Drl	6	90		Trb	15	1926		I	
79	H22b-3511	Shaws School		1911	515	Drl		71		Trb					
80	H22b-3224a	Shellys School		1911	500			58		Trb				U	
81	H22b-3224b	Shellys School	R. J. Collins		500	Drl	6			Trb					
82	H22b-4126	E. W. Knauss & Son	M. B. Biery	1938	500	Drl	6	280+		Trb	5	1938		I	
83	H22b-3929	Quakertown Disposal Plant	J. W. Shaw	3/38	495	Drl	8	300		Trb			260	I	
84	H22b-3735	Miss Carson			505	Drl		72		Trb					
85	H22b-5031a	Ridge Hosiery Co.	W. Shaw	1947	5.5	Drl	6	51		Trb				I	
86	H22b-5031b	Ridge Hosiery Co.	Harold Knierium	1949	525	Drl	6	160+		Trb				U	
87	H22b-5130	School House		1911	525	Drl	6	49		Trb			5		
88	H22b-4920	Central School		1911	520	Drl		73		Trb					
89	H22b-4919	Crouthamel Potatop Chip Co.	W. Shaw	1930	515	Drl	6	165	6c	Trb				D	
90	H22b-6319	Dew Drop Inn			565					Trd				D	
91	H22b-6210	Scholls School		1911	510	Drl		75		Trb					
92	H22b-5810	Zigmund Papciak	W. Shaw	1926	540	Drl	6	108	6c	Trb	11	1926		D	
93	H22b-5700a	Trumbauersville Boro	Kohl Bros.	1938	505	Drl	12-8	365	7c	Trb	5	10-17-38	55	PS	
94	H22b-5700b	Trumbauersville Boro	Kohl Bros.	1941	490	Drl	12-8	254		Trb			72	PS	C

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
95	H22a-6064	Puritan Paper Plates & Products			545	Drl	6	100		Trb				I	
96	H22a-6263	Trumpet Hosiery Co.			530	Drl	6			Trb				U	
97	H22a-4353	Milford Square Parts Co.	W. Shaw	1946	520	Drl	6	70	20c	Trd				I	C
98	H22a-4449	Lester Weiss	W. Shaw	1945	530	Drl	6	64		Trb				D, S	
99	H22a-3361	Tohickon Valley School	M & M Drilling Co.	5/50	595	Drl				Trb					
100	H22a-3061	E. Swamp Mennonite Church	R. J. Collins	1948	600	Drl	8	90	30c	Trb				D	
101	H22a-2859	Brick Tavern Inn			535	Dug	48	19.5	19.5c	Trb	4.9	12/52			
102	H22a-1957	Miller's Convalescent Home	R. J. Collins	1948	595	Drl	6	120		Trb			20	D	
103	H22a-2241	Steinsburg Hotel	W. Shaw	1943	620	Drl	6	103		Trb				D	
104	H22a-2341a	H. E. Klaussfelder		1890	650	Dug	60	30	30c	Trb	23	11/52		D	
105	H22a-2340	Milton Kemmerer			690	Drl	6	140		Trb			8	U	
106	H22a-3335	Clarence R. Boardman	W. Shaw	1937	585	Drl	8	117	10c	Trb	27	12/51			
107	H22a-4033	Spinnerstown Creamery		1917	545	Drl	6	75		Trb	12-14	7/47		I	
108	H22a-4132	Spinnerstown Hotel	H. Herman	1941	550	Drl	6	128	30c	Trb	10	1951			
109	H22a-4430	Spinnerstown School	M. Biery		575	Drl				Trb	45	12/52			
110	H22a-4323	Otto Hippeli			585	Dug	54	16		Trb	6.4	2-4-53		D	
111	H22a-5423	Newman Sleepy Hollow Ranch	C. S. Garber	1938	670	Drl	6	104	16c	Trb					
112	H22a-5424	Newman Sleepy Hollow Ranch	C. S. Garber	1950	660	Drl	6	140	20c	Trb				D	
113	H22a-5618	Eugene Lehman	Joe Mayer	1951	580	Drl	8-6	110	20c	Trb	38.5	12-8-52		D	
114	H22a-5712	James Wunder	Joe Mayer	1952	505	Drl	8	140	25c	Trb	40	1952		D	
115	H22a-5813	Mr. Rader			520		6	80		Trb			15	D	
116	H22a-5812	Geryville Hotel			500	Dug	60	23	23c	Trb	5	11/52			
117	H22a-6341	Walter Repa	W. Repa & W. Wonsidler	1950	520	Drl	8	70	16c	Trd	14	1950		D	
118	H22a-6951	Esten's Sawmill	Esten & Others	1946	465	Dug	48	14.5	14.5c	Trd	4.8	1-20-53		D	
119	H22a-7248	W. K. Rothmund		1850	460	Dug	48	34	34c	Trd				D	
120	H22a-7047	W. K. Rothmund	Rothmund	1920	440	Dug	48	9.5		Trd				D	
121	H22a-7147a	W. K. Rothmund	Rothmund	1927	435	Dug	48	10	10c	Trd				D	
122	H22a-7048	W. K. Rothmund	Rothmund	1938	460	Dug	36	14	14c	Trd	7	1952		D	
123	H22a-7148	W. K. Rothmund	Isaac Moyer	1944	465	Drl	6	68		Trd				D	
124	H22a-7147b	W. K. Rothmund	W. Wonsidler	7/52	450	Drl	8	58		Trd				D	
125	H22a-7745a	Midgard Co.			480	Dug	54	30	30c	Trd	11.5	12-8-52		U	

Well No. Bk-	Location No.	Owner	Driller	Date com-pleted	Alti-tude (feet)	Type of Well	Diam-eter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measure-ment	Yield (gpm)	Use	Chem Anal
126	H22a-7745b	Midgard Co.		1947	500	Drl	8-6	45	31c	Trd	18	1951		D	
127	H22a-8042	John Jabs	J. Campbell	1926	440	Drl	6	83	83c	Trd	22	1926		D	
128	H22c-0555a	W. J. Harbers & Co.			465	Drl	6	50		Trd	7.3	1-28-53			
129	H22c-0555b	W. J. Harbers & Co.		1951	460	Drl	6	29	7c	Trd	5	1951		I	
130	H22d-1400a	E. A. & M. T. Gest			520	Dug	48	20	20c	Trl	4.5	1-28-53		U	
131	H22d-1400b	E. A. & M. T. Gest	Stover	1940	530	Drl	6	75		Trl & Trb	34	1940		D	
132	H22d-0724	Grandview Hospital	Moyer	1936	540	Drl	8	92		Trb	12	1936		D	
133	H22d-2121	North Penn Machine & Tool Co.			300	Dug	60	24	24c	Trl	8-10	1951		D	
134	H22d-2529	Rock Hill Mennonite Church			380	Drl	6	108		Trb			15		
135	H22d-1634	Samalto Hosiery Mills	W. Shaw	1948	350	Drl	8	98		Trl				I	
136	H22b-7819	Sellersville Boro		1908	550	Drl	10	765		Trd			45	PS	C
137	H22d-0228	Sellersville Boro	Ridpath & Potter	1910	490			1,000		Trb				U	
138	H22d-1333	Sellersville Boro		8/49	308	Drl	14-10	750	40c	Trb	10	1949	80		C
139	H22d-1336	American Machine & Metals Inc.	Robert Beyers	1942	335	Drl	8	618	60c	Trb	60	1946	150	I	
140	H22b-6840a	Perkasie Water Supply Co.	Conner & Magee	1914	580	Drl	8	221	41c	Trb	3	1946	70	PS	
141	H22b-6840b	Perkasie Water Supply Co.	Conner & Magee	1915	580	Drl	8	141	60c	Trb	8	1946		PS	
142	H22b-6840c	Perkasie Water Supply Co.	Conner & Magee	1915	580	Drl	8	100	49c	Trb	8	1946		PS	
143	H22b-7539	Perkasie Water Supply Co.	Bollinger	1946	580	Drl	12-8	270	15c	Trb			103	PS	P
144	H22b-7140	Perkasie Water Supply Co.	W. Stothoff	1949	500	Drl	14-10	303	36c	Trb	25	1949		PS	C
145	H22b-0038	Perkasie Park		1910	380	Drl		140		Trb				D	
146	H22d-0039	Perkasie Throwing Mills		1917	370	Drl	8	120		Trb				U	
147	H22d-0338	Perkasie Ice Plant	Bollinger	7/46	395	Drl	8	350		Trb	57	7-31-46	47	U	
148	H22d-0338	Perkasie Ice Plant	J. W. Shaw	1925	395	Drl	8	303	40c	Trb				U	
149	H22d-0641a	Conte & Sons Packing Co.	W. Shaw	1946	315	Drl	6	100+	20c	Trb	20	1949		I	
150	H22d-0641b	Conte & Sons Packing Co.	W. Shaw	1949	320	Drl	6	127	20c	Trb	20	1949		I	
151	H22d-0443	Oliver Wace Greenhouse			310	Drl	8	50		Trb					
152	H22d-0340	H. E. Snyder Cigar Co. Inc.		1924	330	Drl	6	90		Trb				I	
153	H22d-0240	Jay Gee Corp.		1910	330	Drl	6	80		Trb	6	1952	9	I	
154	H22d-0142	Frank Benner			370	Dug	48	16.8		Trb	4.5	8-13-46		T	
155	H22b-8444	Frank Benner	W. Shaw	1935	370	Drl	6	112	20c	Trb	25	1942		D	
156	H22b-8544a	J. Melvin Freed Inc.	W. Shaw	1925	370	Drl	6	57		Trb				E	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
157	H22b-8544b	J. Melvin Freed Inc.	J. W. Shaw	1939	360	Drl	14-10	125	20c	Trb	30	1946	100	I	C
158	H22b-8546	Hedrick's Greenhouse	J. W. Shaw	1922	330	Drl	8	117		Trb	30	1922			
159	H22b-7427	Forrest Lodge	Kohl Pros.	1951	605	Drl	8-6	200	20c	Trd	10	1951		D	
160	H22b-6639	General Crushed Stone Corp	Drake Drill Co.	1903	680	Drl	10-6	1,250		Trd				I	
161	H22b-7753	Penn Ridge School	Douglas Amey	9/52	390	Drl	6	150		Trb	30	1952	20	U	
162	H23a-6500	Lloyd H. Rogers	Howard Moyer	1942	380	Drl	6	75		Trb	30	1949		D	
163	H22b-5363	Sunnyside School	Knerium	1947	510	Drl	6	47		Trb				PS	
164	H22b-4254	Beverly Hall Corp.			460	Dug	60	16	18c	Trd	5.7	1-16-53		D	
165	H22b-4253	Philosophical Publishing Co.	Moyer	1942	470	Drl	6	87	20c	Trd				D	
166	H22b-2743	Earl Cope	D. Amey	1951	520	Drl	6	38	20c	Trd				D	
167	H22b-1154	Quakertown Packing Co.	J. W. Shaw	1934	538	Drl	6	72		Trd				I	
168	H22b-4160a	W. V. Krebs			500	Dug	48	14.0	14c	Trb	6.1	2-11-53		D	
169	H22b-4160b	W. V. Krebs			510	Drl	6			Trd				D	
170	H22b-4260	W. V. Krebs			475	Drl				Trb	85.74	2-11-53		D	
171	H22b-3765a	Andrew Palmer	Sam Moyer	1946	460	Drl	6	135		Trb				D,S	
172	H22b-3765b	Andrew Palmer(Haycock Block)	Knerium	1950	480	Drl	6			Trb				I	
173	G23c-8523	Catholic Church			400		6			Trb			20	PS	
174	H23a-0035	Otts' Garage		1947	530	Drl	6	326	35c	Trb				D	
175	G23c-7127	Palisades Joint High School	L. E. Wieand	9/50	585	Drl	10-8	550	25c	Trl	50	1950		PS	
176	G23c-4537	Lehr's General Store	Knerium	1948	160	Drl	6	82	40c	Trb	15	1949		D	
177	G23c-6336b	Roy Fair	Knerium	7/52	350	Drl	6	50	20c	Trb	8	1952		D	
178	G23c-5941b	Conrad Mattes	Knerium	8/52	540	Drl	6	130	20c	Trl				D	
179	G23c-5941a	Frank Rich	Frank Rich	1947	540	Dug	48	4.5	4.5c	Trl	2.1	2-2-53		D	
180	G23c-6041	Horace Young Ken			510	Dug	48	8	8c	Trl	2.9	2-2-53	5	D	
181	G23c-7644	Nockamixon High School	M. Biery	1934	520	Drl	6	300		Trl			20	PS	
182	G23c-7649	Harmon Wright		1943	470	Drl	6	125		Trl				D	
183	G23c-6560	Robert Culby			570	Dug	60	14	14c	Trd				D	
184	G23d-4403	Levi Diehl	Dominic Kulusy	1949	520	Drl	6			Trd				D	
185	G23d-3801	James Thompson	Stothoff	1928	150	Drl	8	113		Trb				D	
186	G23d-3808	Dinmore's Garage	Stangel		140	Drl	6	65	55c	unc	8	1952		D	
187	G23d-4717	Isaac T. Pursell	Stangel	1940	140	Drl	6	85	8	Trb	27	1940			

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
188	G23d-6827	G. Beck		1949	140	Drn	1.5	25	25c 2.5s	Trb				D	
189	G23d-8526	Roy Cochran	John Stiger	1942	180	Drl	6	85	30c	Trb	33	1942		D	
190	H23b-0629	Oberacker Hotel		1937	160	Drl	6	168		Trb				D	
191	H23b-1928	Constantine Poolos		1928	270	Drl	6	100		Trb,Trl	35	1951		D	
192	H23b-2703a	Walter G. Shive			340	Dug	48	14	14c	Trb	5.9	2-11-53		U	
193	H23b-2703b	Walter G. Shive	Moyer	1948	320	Drl	6	108	20c	Trb,Trl				D,S	
194	H23b-3607a	Wormansville Church			390	Dug	42	11	11c	Trb	3.7	12/52		U	
195	H23b-3607b	Wormansville Church			395		6	60		Trb	12		5		
196	H23b-3608	Leonard Schaible, Jr.			420	Drl		100		Trb	4	1952		D	
197	H23b-3002	James A. Michener	Wiley		405	Drl	6	320		Trb	180	1952		D	
198	H23b-2601	Rodene Seidenberg	Moyer	1944	300	Drl	6	147	30c	Trb					
199	H23a-0164	Mrs. Mary Girjatowica	Holman	1951	525	Drl	6	77		Trl				D	
200	H23a-1946	Ottsville Dairymen's Asso.			360	Drl	6	220		Trb			15+		
201	H23a-2751a	Estate of Harry Mood			340	Dug	36	25	25c	Trb	7.3	1952			
202	H23a-2751b	Estate of Harry Mood			355	Dug	60	25	25c	Trb	3.1	12/52			
203	H23a-3652	Mrs. Mary G. Osborn	Pat Flaherty	1929	300	Drl	6	38		Trb	2	1951			
204	H23a-4958	William Fretz & Son		1912	450	Drl	6	204		Trb	38	1950	10	U	
205	H23a-4958	William Fretz & Son	Earl West & Son	4/51	460	Drl	6	154		Trb			10	U	
206	H23a-5060	G. E. Leworthy			460	Drl	6	215		Trb			10	D,S	
207	H23a-5059	Pipersville School	Sam Moyer	1952	470	Drl	6	80	20c	Trb					
208	H23a-5158	Mrs. Franz Burger			470	Drl	6	165		Trb			12		
209	H23a-6652	John J. Belli			480	Dug	54	20	20c	Trl	6.7	12-10-52		U	
210	H23a-6652	John J. Belli	D. Amey	7/52	460	Drl	6	75		Trl					
211	H23a-6652	John J. Belli	D. Amey	8/52	480	Drl	6	75		Trl					
212	H23a-6340	Deep Run School	M. Moyer	1952	450	Drl	6	100+	20c	Trb			4		
213	H23a-5137a	Ernest O. Puder		1890	430	Dug	84	17		Trb	4.4	12-10-52		D	
214	H23a-5137b	W. F. Fretz & Son	Rutherford	1929	445	Drl	6	128		Trl,Trb				D	
215	H23a-5326	H. F. Myers			400	Drl	6	104		Trb	38	1952	6		
216	H23a-5104	Charles Geisel	M. B. Biery	1940	545	Drl	8	227	40c	Trl,Trb	26	1952		D	
217	H23a-6737	Wm. S. Gahman			460	Dug	42	12	12c	Trb	3	1952		D	
218	H23a-3521a	Frank Stefanic Jr.			485	Dug	54	13	13c	Trb	3.7	2-10-53		U	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
219	H23a-3521	Frank Stefanic Jr.		1937	495	Drl	6			Trb				D	
220	H23a-1510	Albert Kinzler	H. Knierium	5/52	530	Drl	6	40	40c	Trd	6	1952		D,S	
221	H23a-2909	W. Gulden			440		6	60		Trb			20		
222	H23a-6719	H. H. Hartford			450	Drl	6	123		Trl,Trb	35	1952	15	D,S	
223	H23a-7212	Bedminster Hosiery Mill		1938	460	Drl	6	120	20c	Trl,Trb			3	I	
224	H23c-0024	H. Daroff & Sons	Moyer	4/47	540	Drl	6	168		Trl	60	5-15-47	25	I	
225	H23c-0224	Dublin Hosiery Mill		1937	540	Drl	6	90		Trl			20	I	
226	H23c-0223	Dublin Hosiery Mill	Moyer	1945	535	Drl	6	140		Trl			18	I	
227	H23c-0427	Greenlawn Hosiery Mill		.1927	520	Drl	6	80		Trl			10	I	
228	H23b-0833	J. A. Moyer	H. Moyer	1944	620	Drl	6	85		Trb	8.1	12-8-52		D,S	
229	H23c-1710a	Vincent Pischel			630	Dug	48	22	22c	Trl	7.2	1-27-53		I	
230	H23c-1710b	Vincent Pischel	S. Moyer		610	Drl	6	60	20c	Trl,Trb				D	
231	H23c-2600	Fred W. Hagy		9/51	650	Drl	10-8	100	50c	Trl,Trb			20	U	
232	H23c-0402	Hilltown High School		1947	440	Drl	6	125	50c	Trl,Trb				PS	
233	H23c-0400	J. M. Grass	S. Moyer	1947	420	Drl	6	135	50c	Trb	30	1952		D	
234	H22d-0061	Charles J. Fehl	S. Moyer	1920	360	Drl	6	160		Trl,Trb				I,S	
235	H22d-1463	Hilltown Twp. Elementary School	S. Moyer	9/52	480	Drl	10-8	210	50c	Trl,Trb				U	
236	H22d-1551	C. D. Moyer		1928	420	Drl	6	120		Trb	42	1946	38	I	
237	H22d-1551	C. D. Moyer		1940	420	Drl	8	245		Trb	42	1946	50	I	
238	H22d-1655	I. G. Rosenberger			415	Dug	66	18	18c	Trb	3.3	12-10-52		D	
239	H22d-1955	John Shive			440	Drl	6	117		Trb				D	
240	H22d-3937	C. W. Loop	Pat Flaherty	1935	480	Drl	6	57.5	25c	Trb	3	1935		I	
241	H22d-5247	E.Mennonite Convalescent Home		1913	390	Drl	8	103		Trl	26	10/52	15	D	
242	H22d-3749	Frank Lesh	Pat Flaherty	1945	600	Drl	6	120		Trb				D	
243	H22d-4761a	Adam H. Lengel			520			80		Trl			20	U	
244	H22d-4761b	Adam H. Lengel		1947	550	Drl	6	170	12c	Trl					
245	H23c-3307	Catholic Church		1927	660	Drl	6	100		Trl			10	PS	
246	H22b-2957	A. Mientus		1946	560	Dug	72	19	19c	Trd	2.0	12-12-52		D	
247	H23c-5923	Chalfont Boro Water Works		1931	250	Drl	8	388		Trl	60	8-19-46	8	X	
248	H23c-6320	Chalfont Boro Water Works		1932	280	Drl	8	720		Trl	30	8-19-46	20	U	
249	H23c-5316	Chalfont Boro Water Works		1935	390	Drl	8	200		Trl	30	8-19-46	8	E	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/ or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
250	H23c-5316	Chalfont Boro Water Works		1938	390	Drl	8	300		Trl	50	8-19-46	20	PS	
251	H23c-5316	Chalfont Boro Water Works	J. Wiley	1938	390	Drl	8	300		Trl				U	
252	H23c-5727	Chalfont Boro Water Works	J. Wiley	9/46	275	Drl	10-8	187		Trs	6	6-26-47	125	PS	C
253	H23c-5619	Chalfont Boro Water Works	Ridpath & Potter	8/50	290	Drl	12-8	201	33c	Trs	40.5	11-13-52	44	PS	
254	H23c-5718	Peter Helberg Co.	J. Wiley	1914	310	Drl	6	90		Trl			5	U	
255	H23c-5718	Peter Helberg Co.	J. Wiley	1939	310	Drl	8	204	23c	Trl	0-10	1946	23	D,S	
256	H22c-6220	Chalfont Hosiery Co.		1927	260	Drl	6	100		Trl			5	I	
257	H23c-5329	Oliver Ferrell	Kohl Bros.	1951	275	Drl	8	350	27c	Trs			60		
258	H22d-5959	Hockenberg & Gelb			360	Drl	6	85		Trl				I	
259	H22d-6159	K & M Hosiery Co.	Flaherty	7/51	320	Drl	8	148		Trb			2.5	I	
260	H23c-4915	Newville School	Coulton		340	Drl	6	78		Trl	20	1952	5		
261	H23c-3133	Louis F. Argentin	H. Gargas	1947	325	Drl	6	285		Trl	15	1952	5	D	
262	H23c-5136	New Britain School			300	Drl	6			Trs			5	D	
263	H23c-5038	Victor Silk Hosiery Co.	J. Wiley	1930	310	Drl	8	222		Trs	10	1946	60	I	
264	H23c-5139	Bitzer Dry Cleaning			320	Drl	6	68.8		Trs	5	12-17-52	20	I	
265	H23c-5139	Bitzer Dry Cleaning			320	Drl	6	90		Trs	4.5	1952	5	E	
266	H23c-5139	Bitzer Dry Cleaning	J. Wiley	6/52	320	Drl	8	125		Trs			30	I	
267	H23c-5450	National Agricultural College			300	Drl	8	400	80c	Trs			35	E	
268	H23c-5450	National Agricultural College			305	Drl	8	400	60c	Trs			75	E	
269	H23c-5348	National Agricultural College	W. Stothoff	1947	325	Drl	8	400		Trs	54	1952	100	D,S	
270	H23c-5052	National Agricultural College	J. Wiley		350	Drl	8	140		Trs			25	D,S	
271	H23c-5052	National Agricultural College	J. Wiley		350	Drl	8	140		Trs			25		
272	H23c-5256	Andre Greenhouse			330	Drl	6	210		Trs	20	9-11-47	75	E	
273	H23c-5256	Andre Greenhouse	J. Wiley	1927	340	Drl	6	185		Trs	30	9-11-47	300	I	
274	H23c-6764	Neshaminy Manor Bucks Co.Home	Pat O'Connor	1944	220	Drl	8	210		Trl	30	1946	90	D,S	C
275	H23c-6163	Doylestown Twp. School		1946	250	Drl	6	280		Trs	12	1953		PS	
276	H23c-5763	Tabor School for Children			280	Drl	6	80		Trs	20	1952	6	D	
277	H23d-4403	Doylestown Boro Water Works			315	Drl	8	600	105c	Trs	15.0	11-13-52	90	E	P
278	H23d-4403	Doylestown Boro Water Works			315	Drl	8	160		Trs	13.7	11-13-52	140	E	P
279	H23d-4403	Doylestown Boro Water Works			320	Drl	8	200		Trs	3.7	11-13-52	180	E	P
280	H23d-4303	Doylestown Boro Water Works		1931	340	Drl	8	250	38c	Trs	22.7	11-13-52	15	E	

Well No. Bk-	Location No.	Owner	Driller	Date com-pleted	Alti-tude (feet)	Type of Well	Diam-eter (in.)	Depth (feet)	Depth of casing and/ or screen (feet)	Aquifer	Water Level (feet)	Date of measure-ment	Yield (gpm)	Use	Chem Anal
281	H23d-4304	Doylestown Boro Water Works		1939	330	Drl	8	250	24c	Trs	24.9	11-13-52	100	E	P
282	H23d-4403	Doylestown Boro Water Works		1942	310	Drl	8	250	24c	Trs	10.3	11-13-52	135	E	P
283	H23c-3763	Doylestown Boro Water Works	W. Stothoff	1948	370	Drl		270		Trs	36.5	11-12-52	300	PS	P
284	H23c-4557	Doylestown Boro Water Works	W. Stothoff	2/52	345	Drl		396		Trs	1.5	11-12-52	350	PS	C
285	H23c-4961	Doylestown Ice Co.			350	Drl	8	200+		Trs	29.1	1-28-53			
286	H23c-4961	Doylestown Ice Co.			350	Drl	8	200		Trs	33	1946		I	C
287	H23c-4660	MacEvan & Smith Inc.			390	Drl	6	137		Trs				I	
288	H23c-4560	Smith Dairy	Wiley		390	Drl	8	190		Trs			70	I	
289	H23c-4560	Smith Dairy	Wiley		390	Drl	8	250		Trs			70	I	
290	H23c-4464	Wm. Neis & Son	Coulton		420	Drl	6	94	60c	Trs			25	I	
291	H23c-4161	Lou Jaffe	J. Wiley	1949	360	Drl	8	150		Trs	22	1952	150	I	
292	H23c-4162	Sommer Maid Co.			380	Drl	6	85		Trs			40	I	
293	H23c-4162	Bucks Co. Frozen Products Co.	J. Wiley	1942	375	Drl	8	168		Trs			60	I	
294	H23c-4062	Prudential Worsted Co.	J. Wiley		370	Drl	8	158		Trs			170	I	
295	H23c-4063	Modern Cleaners	J. Wiley	1939	390	Drl	6	62		Trs	12	1939	15	U	
296	H23d-3500	Moravian Pottery & Tile Co.	J. Wiley	1912	400	Drl	6	125		Trs	10	1952		I	
297	H23d-4810	Edward J. Byrne	H. Dean	1949	360	Drl	6	85		Trs				D	
298	H23d-5421	R. Funk & Co. Inc.		1951	325	Drl	6	.165		Oc			·3	I	C
299	H23d-5322	Furlong Mfg. Co.		1945	320	Drl	6	200		Oc	35	1952	5	I	
300	H23c-3643	Pine Run Hosiery Mill			310	Dug	60	30		Trs				I	
301	H23c-3059	Penna. Color & Chemical Co.	J. Wiley	12/46	300	Drl	6	153		Trs	0-10	1952	19	I	
302	H23c-2858	Eastern Rotorcraft Corp.	E. West & Son	5/52	300	Drl	6	80		Trs	20	6/52	10	I	C
303	H23c-2863	Phila. Metal Window Co.	Moyer	1949	340	Drl	6	86		Trs			8	I	
304	H23c-2351	F. E. Hellerick Store	H. Moyer	1943	400	Drl	6	100		Trs,Trl	10	1952	10	D	
305	H23c-1659	Hillcrest Recreation Center			490	Drl	6	200		Trl				PS	
306	H23c-0542	L. C. Stryker	11/47	11/47	630	Drl	6	113		Trl	40	1952	10	D	
307	H23a-7450	Myers Foods Inc.			520	Drl	6	91		Trl			2	I	
308	H23a-7450	Myers Foods Inc.	Moyer	1949	520	Drl	6	76		Trl	15	1952	20	I	
309	H23a-8254	Keller Glove Mfg. Co.	H. H. Moyer	1941	580	Drl	6	76	13c	Trl	8.5	12-8-52	11	I	
310	H23a-8254	Keller Glove Mfg. Co.	Sam Moyer	11/50	580	Drl	8	200		Trl	8.5	1952	22	I	
311	H23b-8307	Moldavanyi Pork Products	Cotton	1931	420	Drl	6	88		Trl	0-5	1947	5	I	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
312	H23b-6500	William Sames	H. Moyer	1950	525	Drl	6	75		Trl	5	1952	17	D,S	
313	H23b-5210	H. J. Holms Store	J. Wiley		480	Drl	6	69		Trl	6.5	12-8-52		D	
314	H23b-4320	Bucks County Council	J. Wiley	1937	430	Drl	6	330		Trl	60	1952	3	D	C
315	H23b-4519	Bucks County Council	J. Wiley	1940	460	Drl	6	333	22c	Trl	50	1952	5	D	
316	H23b-4320	Bucks County Council	H. Knierium	2/48	430	Drl	6	336	15c	Trl	30	1952	5	E	
317	H23b-4320	Bucks County Council	H. Knierium	1949	420	Drl	6	370	20c	Trl	50	1952		D	
318	H23b-4413	Commonwealth of Pennsylvania			265	Dug	36	12		Trl	9.2	6-16-48		U	
319	H23b-5331	Joseph Dobron	Moyer	1948	90	Drl	6	75		Trl			10	D	
320	H23b-6343	Robert Hellyer Store	Moyer	1949	90	Drl	6	84		Trs			2	D	
321	H23b-7317	Rocky Ridge School			465	Drl	6	30.5		Trl	10.4	12-9-52			
322	H23b-7832	J. P. Bartleman	Ziegenfuss		220	Drl	6	85		Trs	5	1952		D	
323	H23b-8161	New Hope-Solebury Elem.School	Ziegenfuss	1938	400	Drl	6	165		Trs			12	PS	
324	H23b-8161	Joseph E. Sanford	C. Rutherford	1940	390	Drl	6	80		Trs	15	1952		D	
325	H24a-6710	Jennie M. Rodgers	T. Moore		80	Drl	6	70		Trs	25	1952		D	
326	H24a-8205	Solebury School	Ziegenfuss	1930	140	Drl	8	175		Ob	10	1930		PS	
327	H24a-8217	Solebury School			110	Drl	6	175		Trb				PS	
328	H24c-0721	New Hope High School	Ziegenfuss	1931	150	Drl	6	225		Trb				PS	
329	H24c-0625	Huffnagle Press	H. Dean	1938	80	Drl	6	80		Trb	16	1952		D	
330	H24c-0724	Universal Paper Bag Co.	T. Moore	1915	100	Drl	8	511		Trb	20	1946	32	I	C
331	H24c-1527	Union Mills Paper Mfg. Co.	H. Dean	1/38	60	Drl	6	250	19c	Trb			3	D	C
332	H24c-2220	M. W. Greene	Ziegenfuss		340	Drl	6	100		Trb				D	
333	H24c-2400	Bertram I. DeYoung	H. Dean		350	Drl	6	55		Trd	10	1952		D	
334	H23d-1664	C. R. Naylor	H. Dean		260	Drl	6	86		Cc				D	
335	H23d-2046	Buckingham Friends School			360	Drl	6	190		Trs			2	D	
336	H23d-0816	John C. Myers			380	Drl	6	73		Trs			5	D,S	
337	H23c-3163	Thrift Feed Mill			360	Drl	6	60		Trs	15	1952		I	
338	H23d-3131	Hieber Machine Co.		1949	320	Drl	8	140		Trs				I	
339	H23d-3131	Hieber Machine Co.		1950	320	Drl	8	160		Trs				I	
340	H23d-4439	Walter M. Reiff	J. Wiggins	1924	240	Drl	6	85	65c	Cch	14	1924		D	C
341	H23d-4953	W. W. Day			260	Drl	6	56.5		Trb	21.0	12-4-52		D	
342	H23d-5461	Van Pelt & Co.			230	Drl	6	75		Trb				I	C

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343	H23d-6451	Cooper Textile Mills		1949	210	Drl	8	100		Trb	20	7/52	10	D	
344	H23d-5734	Josephine J. Carver		1947	280	Drl	6	80		Trb				R	
345	J23b-0529	Maple Farm Pork Products			320	Drl	6	185		Trs	60	1952		U	
346	J23b-0022	Warwick Township School		1919	350	Drl	6	165		Trl	9	1952	2	D	
347	J23b-0022	Warwick Township School			350	Drl	8	400		Trl	13.2	12-1-52		U	
348	J23b-0019	Ludwig Fetzer Greenhouse		1927	350	Drl	6	150	10c	Trl	8-20	1946		I	
349	J23b-1516	Hartsville Hotel			260	Dug	36	30		Trs				D	
350	H23c-6936	Warrington Meat Packing Co.	Musselman		270	Drl	6	135		Trl	15	1952	6	E	
351	H23c-6936	Warrington Meat Packing Co.	O'Donnell	10/51	270	Drl	6	296		Trl	15	1952		I	
352	J23a-0133	Dress & Ackerman Greenhouse			340	Drl	6	208		Trl	10	1946	9	I	
353	J23a-0133	Dress & Ackerman Greenhouse		1948	340	Drl	6	188		Trl	10.4	12-5-52			
354	J23a-0447	John McCrath Sons	Carson		320	Drl	6	82		Trl	40 .	1952	3	I	
355	H23c-8561	Vincent's Warrington Inn	J. Wiley		415	Drl	6	390		Trs			9	D	
356	J23a-0257	Recreation Center Solidarity	J. Wiley	1937	360	Drl	6-8	200		Trs			35	PS	
357	J23a-0760	Warrington Hosiery Co.	J. Wiley	1946	320	Drl	8	350		Trs	72	12-1-52		I	
358	J23a-0860	Valley Green Hosiery Co.	J. Wiley	1947	320	Drl	8	450		Trs	68	12-1-52		I	
359	J23a-1757	Acme Press		7/51	220	Drl	6	54		Trs				D	
360	J23a-2658	St. Joseph's School	J. Carson	4/50	300	Drl	6	140		Trs	10	1952	25	D	
361	J23b-2405	Christ's Home for the Aged		1910	280	Drl	6	80		Trs	50	1952	10	D	
362	J23b-2606	Christ's Home Farm	J. O'Donnell	1924	290	Drl	6	150	12c	Trs	28	1924	10	D,S	
363	J23b-2612	Christ's Homq for Children	J. O'Donnell	1915	300	Drl	6	161	12c	Trs	90	7/46	75	D	
364	J23b-2612	Christ's Home for Children	J. Wiley	1932	300	Drl	6	200		Trs			35+	D	
365	J23b-3213	Warminster Hosiery Co.			295	Drl	6	56		Trs	15	1952		I	
366	J23b-4219	U. S. Housing Project	Ridpath & Potter	1943	280	Drl	10-8	300	16c	Trs	170	8-9-43		PS	C
367	J23b-4719	U. S. Housing Project	Ridpath & Potter	1943	300	Drl	8	300		Trs	36.5	11-23-43		PS	
368	J23b-4416	V. LaRosa & Sons Inc.	J. O'Donnell	7/50	290	Drl	6	600		Trs	53	1952	50	I	
369	J23b-4415	V. LaRosa & Sons Inc.	J. O'Donnell	9/50	290	Drl	6	236		Trs	72	1952	90	I	
370	J23b-4517	Fischer & Porter Co.	J. O'Donnell	1940	300	Drl	6	190	15c	Trs	63	10-17-46	25	I	
371	J23b-4518	Fischer & Porter Co.	Rempert	12/48	300	Drl	8	474		Trs	58	12/48		I	
372	J23b-4518	Fischer & Porter Co.	Stothoff	10/52	300	Drl	10-8	600		Trs	58	10/52		U	
373	J23b-3422	U.S. Naval Air Development Sta.	J. Wiley	1941	330	Drl	8	250		Trs			125	I	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
374	J23b-3322	U.S.Naval Air Development Sta.	J. Wiley	1941	330	Drl	8	250		Trs			125	D	
375	J23b-3523	U.S.Naval Air Development Sta.	Ridpath & Potter	1942	340	Drl	8	600		Trs			140	D	
376	J23b-3423	U.S.Naval Air Development Sta.	Ridpath & Potter	1942	335	Drl	8	600		Trs			140	D	
377	J23b-3127	U.S.Naval Air Development Sta.	J. O'Donnell	2/48	320	Drl	6	352	65c	Trs			40	D	
378	J23b-3629	U.S.Naval Air Development Sta.	J. O'Donnell	10/49	360	Drl	6	273		Trs			10	D	
379	J23b-4634	Davisville Hosiery Mills Inc.		1928	240	Drl	6	270		Trs	15	1952	50	I	
380	J23b-4736	William D. Lynch	A. Ott	1926	230	Drl	8	128	20+c	Trs	14	1946	50	I	
381	J23b-4939	Penna. Frosted Foods Corp.	J. Wiley	1946	260	Drl	8	324	29c	Trs	67	1946	200	I	
382	J23b-4939	Penna. Frosted Foods Corp.	J. Wiley	1946	260	Drl	8	302	24c	Trs	58	1946		E	
383	J23b-5240	Hyzer & Lewellen	H. Weiss	1945	240	Drl	6	57		Trs	10	2-4-53			
384	J23b-5140	Up.Southampton-Warminster HS.	J. Rulon		260	Drl	8	225	90c	Trs				PS	
385	J23b-5143	Southampton Water Authority	Rempfer & Son	3/48	252	Drl	8	369	150c	Trs	12	8/48	50	PS	C
386	J23b-5640	W. Boettcher			235	Dug	60	28		Trs	12	1952	2	I	
387	J23b-5543	Andre Greenhouses Inc.		1912	260	Drl	8	250		Trs			55	I	
388	J23b-5546	Graenz Hosiery Mill			260	Drl	10-8	140		Trs	14	1952	5	I	
389	J23b-5950	Fred J. Bux	J. Wiley		200	Drl	8	220		Trs				D	
390	J23b-5950	Fred J. Bux	J. Wiley	1926	210	Drl	6	193		Trs	25	1946		U	C
391	J23b-5853	E. P. Morris	E. Cook & Son	1941	200	Drl	6	125		Trs	60	1953		D	
392	J23b-4959	Bell Telephone Co.	Ridpath & Potter	7/51	160	Drl	6	125	34c	Trs	26	7-25-51	5	D	
393	J23b-5861	Churchville Hosiery Mill			95	Drl	6	27		Trs	4	11-28-52	2	D	
394	J23b-7861	Somerton Springs Pool	O'Donnell	1926	180	Drl	6	165	50c	Ch				D	
395	J23b-7861	Somerton Springs Swimming Club	J. O'Donnell	1926	180	Drl	6	165	60c	Ch	5+	7-7-47	125	PS.	C
396	J23b-7861	Somerton Springs Pool	O'Donnell	1927	180	Drl	8	318		Ch			100	U	
397	J23b-7861	Somerton Springs Pool	O'Donnell	1930	180	Drl	6	85	10c	Ch	6.7	12-18-52		U	
398	J23b-6463	Taylor Harris	J. Corson	1942	220	Drl	6	54		gn	15	1953		D	
399	J24a-6403	Lower Southampton Elem. School	Ridpath & Potter	1950	240	Drl	8-6	540		gn	40	1953		PS	
400	J24a-8300	Hugo Hoelper		1950	200	Drl	6	55		gn				D	
401	J24a-6514	Robin Tool & Die Works	N. Cook	1946	230	Drl	6	50		gn	19	1946	5	I	
402	J23b-4960	Caslon Knitting Co.	W. Roland Raab	3/51	180	Drl	6	95		Trs	20	1952	7	I	
403	J23b-3849	Awckland Sunnyside Farms	G. Weiss	1933	290	Drl	6	120		Trs			50	D	
404	J23b-3849	Awckland Sunnyside Farms		1941	290	Drl	6	110		Trs			17	D	

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405	J24a-3902	Charles Wilson Greenhouse		1920	170	Drl	6	260		Trs	50	1946	35	I	
406	J24a-3419	A. C. Sodano		1918	145	Drl	8	105		Trs	25	1946	65	I	
407	J24a-3420	A. C. Sodano		1918	145	Drl	8	205		Trs	25	1946	300	E	
408	J24a-3209	Glass Hosiery Co.	Weiss		210	Drl	6	54		Trs	20	1952		I	
409	J23b-2759	Frey Machine Prod.	H. Weiss	1949	370	Drl	6	80		Trs	20	1952	5	D	
410	J23b-2459	George Hilgenberg Pork Prod.	H. Weiss	1938	280	Drl	8	52		Trs			30	I	
411	J23b-2458	George Rucker Greenhouse	H. Weiss	1926	280	Drl	8	165		Trs	12-20	1946	50	I	
412	J23b-2360	William F. Wendig			295	Dug	36	21.2		Trs	10.3	11-28-52		U	
413	J23b-0860	Elmer Fulmer	G. Weiss		300	Drl	6	90		Trs	20	1953	4	D,S	
414	J23b-0860	Elmer Fulmer	G. Weiss	8/52	300	Drl	6	127		Trs	20	1953	30	I	
415	H23d-8150	Davis Feed Mill			160	Drl	6	125		Trl	.			D	
416	H24c-7500	Penns Park Hotel			340	Drl	6	80		Trl	11.8	12-4-52		D	
417	H24c-7503	Wrightstown Twp. School			350	Dug		28		Trb,Trl					
418	H24c-7408	James E. Hilborn	Stothoff		360	Drl	8	132		Trl			8	D	
419	H24c-8506	Robert G. Anderson	Wiley & Son	1923	160	Drl	6			Trl	15	1953			
420	H24c-6914	J. D. Datesman	J. Wiley		325	Drl	6	165		Trb	5	1952	5	D,S	
421	H23d-5864	Wrightstown Twp. School			245	Dug		30		Trb				D	
422	H24c-4213	Edward Leedom	H. Dean		140	Drl	6	98		Trb	16	1952	2	D	
423	H24c-5732	Woodhill School	Ziegenfuss	11/52	225	Drl	6	202		Trb	71	12-1-52		U	
424	H24c-3336	John Barlow	Ziegenfuss	1938	110	Drl	8	32		unc,Trd	15	1953		D	C
425	H24c-4043	J. G. Penniman			70	Drl	6	80		unc,Trb				D	
426	H24c-4758	Sol Feinstone			80	Drl	6	108		unc,Trb	6	1952	10	D,S	
427	H24c-6664	J. B. Berks	F. Ziegenfuss	6/51	180	Drl	6	95		Trl,Trb			7		
428	H24d-5801	Washington Crossing School			50	Drl	6	90		unc,Trb				D	
429	H24d-6708	K. W. Smith			40	Drl	6	60		unc,Trl				D	
430	H24c-7554	George Balderston			260	Drl	6	110		Trl	20	1952	2	D	
431	H24c-7554	George Balderston	Rempfer & Son	3/52	270	Drl	6	194		Trl	20	1952	12	S	
432	J24b-0419	Pine Run Farm Supply Co.	J. Hulon	1901	35	Drl	8	210	10c	Trs	15	1925	180	I	C
433	J24b-0718	Yardley Water & Power Co.		1936	105	Drl	12-10	403	80c	Trs	59	1936	260	PS	P
434	J24b-1533	Yardley Water & Power Co.	J. Hulon	5/37	40	Drl	12-10	554	34c	Trs	17	5-25-37	135	PS	C
435	J24b-0718	Yardley Water & Power Co.		1945	110	Drl	14-10	485	45c	Trs	63	6-9-45	440	PS	P

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Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
436	J24b-2624	Yardley Water & Power Co.		1951	130	Drl	6	198		gn			15	PS	C
437	J24b-0718	Yardley Water & Power Co.	Ziegenfuss	1953	105	Drl				Trs				PS	
438	J24b-2100	Joseph Heacock Co.	O'Donnell & Son	1914	155	Drl	6	180		Trs	8	8-28-46		X	
439	J24b-2100	Joseph Heacock Co.	O'Donnell & Son	1914	155	Drl	6	180		Trs				X	
440	J24b-2101	Joseph Heacock Co.	O'Donnell & Son	1927	150	Drl	10	280	30c	Trs	8	8-28-46	40	I	
441	J24b-2101	Joseph Heacock Co.	O'Donnell & Son	1927	150	Drl	10	210	30c	Trs	8	8-28-46	35	I	
442	J24b-2101	Joseph Heacock Co.	Ziegenfuss	1948	150	Drl	12	515	240c	Trs	18	10/48	150	I	
443	J24a-1236	Newtown Artesian Water Co.			210	Drl	6	110	20c	Trs	35	4-13-98	120	X	
444	J24a-1236	Newtown Artesian Water Co.			210	Drl	6	112	20c	Trs	100	1946	100	U	
445	J24a-1237	Newtown Artesian Water Co.			210	Drl	6	177	20c	Trs	100	1946	210	PS	C
446	J24a-1236	Newtown Artesian Water Co.			210	Drl	6	220		Trs	85	8-22-46	200	PS	
447	J24a-1236	Newtown Artesian Water Co.	J. Rulon	2/13	210	Drl	'12	339	19c	Trs	100	8-22-46	325	PS	
448	J24a-5733	W. C. Van Sant			200	Drl	6			gn				D	
449	J24a-5733	Van Sant Hosiery Co.		1947	200	Drl	8			gn			35	I	
450	J24a-6133	Parkland Water Co.			205	Drl				gn				U	
451	J24a-6135	Parkland Water Co.	J. Rulon	7-14-31	190	Drl	10-8	222	66c	gn	36	10-1-46	45	PS	C
452	J24a-6334	Parkland Water Co.	Ridpath & Potter	7-20-39	190	Drl	15-10	430	75c	gn	15	7/39	6	U	
453	J24a-6336	Parkland Water Co.	J. Rulon	6-18-40	140	Drl	12-8	198	57c	Cch	8	11-20-40	25	PS	C
454	J24a-6237	Parkland Water Co.			180	Drl				gn			80	PS	P
455	J24a-6040	Langhorne Spring Water Co.		1926	145	Drl	10-8	154	92c	gn	4	6-22-46	40	U	
456	J24a-5940	Langhorne Spring Water Co.	J. Rulon	12-20-29	160	Drl	10-8	225.5	150c	gn	3	1-7-30	60	U	C
457	J24a-5940	Langhorne Spring Water Co		1932	175	Drl	10-8	300	150c	gn	10	3-11-32	175	PS	
458	J24a-6242	Langhorne Spring Water Co.	J. Rulon	4-8-52	75	Drl	10-8	504	25c	Cch	17	4/52	100	PS	C
459	J24a-7446	J. E. Fricke & Co.	O'Donnell & Son	1936	40	Drl	6	150	35c	ws	18	1936	10	D	
460	J24a-7650	William Vornhold		1896	35	Dug	48	35		ws	28	8-28-46	5	I	
461	J24a-7650	William Vornhold			35	Drl		150±		ws				D	
462	J24a-7551	O.K.O. Plush Co., Inc.			50	Drl	8-6	300	30c	ws	16	1952	18	D	C
463	J24a-7551	O.K.O. Plush Co., Inc.	J. Rulon	2-8-39	45	Drl	8	265		ws	20	8-28-46	17	I	
464	J24a-6717	Hungarian Club	J. Rulon	1947	155	Drl		115	31c	gn	30	1947	20	D	
465	J24a-7210	Trevose Public School	O'Donnell & Son	1923	165	Drl	6	120	11c	gn	38	1923	60	D	
466	J24a-7509	Elwell Hosiery Mill			125	Drl	6	95		Cch	15	1952		D	

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467	J24a-8215	American Standard Corp		1946	170	Drl	6	80		ws	20	1946		D	
468	J24a-8216	Clover Motel	G. Widman		170	Drl	6	48		ws	6	1953		D	
469	J24a-8316	Atlantic Refining Co.	N. A. Cook	1953	165	Drl				ws				I	
470	J24a-8312	Cedar Hosiery Co.	Cook & Son	4/41	165	Drl	6	80		ws	20	1952	5	I	
471	J24a-8311	Hi-Way Pool	J. O'Donnell	1927	165	Drl	6	300	31c	ws	12	1927	40	I	C
472	J24a-8311	Hi-Way Pool	J. O'Donnell	1928	165	Drl	8	300	49c	ws	9	1928	35	D	
473	J24a-8412	Hi-Way Pool	J. O'Donnell	1928	160	Drl	6	200	20c	ws	5	1928	75	D	
474	J24a-8412	Roosevelt Cemetery Co.	J. O'Donnell	1928	160	Drl	8-6	150	60c	ws	20.3	2-5-53	25	D,Irr	
475	J24a-8513	Roosevelt Cemetery Co.	J. Wiley	1937	160	Drl	8	500		ws			50	D,Irr	
476	J24c-1127	Brown Septic Tank Co.	W. Haldeman	1952	110	Drl	6	52		ws	10	1952	4	I	
477	J24c-1627	Bensalem Twp. High School	J. Rulon	4-16-48	105	Drl	16-8	300	-89c	ws	20.8	1953	15	D	
478	J24c-4312	Frank Vattino Greenhouse			50	Dug	132	14		unc	5	7-7-47		D,Irr	
479	J24c-4412	Hargeld Ribbon Mills, Inc.	W. Haldeman	1948	30	Dug,Drl	40-6	63		unc				I	C
480	J24c-4115	W. & H. F. Evans Greenhouse	Artesian Drlg. Co.	1914	45	Drl	8	257	27c	ws	10	1914	12	U	
481	J24c-4115	W. & H.F. Evans Greenhouse			45	Dug	168	30		unc	5.9	7-29-53		Irr	
482	J24c-3322	St. Charles Borromeo School			90	Drl	8	225		unc,ws				D	
483	J24c-3622	St. Elizabeth Convent		1891	65	Drl	8	250		ws	14	10/44		U	
484	J24c-3622	St. Elizabeth Convent			50	Drl	8	250		ws			28	D	
485	J24c-3523	St. Elizabeth Convent	J. Brown		80	Dug				unc					
486	J24c-3523	St. Elizabeth Convent	J. O'Donnell		75	Drl	8	400±		ws			90	D	
487	J24c-3525	F. A. Simons Brothers			45	Drl				unc,ws				D	
488	J24c-3226	Frank J. Lotz	J. Rulon		80	Drl	8	450	250c	ws				PS	C
489	J24c-3128	Holy Ghost Missionary College			75					ws			10		
490	J24c-3128	Holy Ghost Missionary College	J. O'Donnell	1934	75	Drl	8	365	36c	ws	8	1951	14	D	
491	J24c-3127	Bensalem Twp. High School			80	Drl	8	390		ws					
492	J24c-3030	Tochterman's Garage			65	Drl				ws				D	
493	J24c-3330	Badenhausen Corp.	J. O'Donnell	1920	35	Drl	8	505		ws	30	10-2-46	20	I	
494	J24c-3730	Madsen Machine & Foundry		1915	30	Drl	8	260		ws	8	10-2-46		I	
495	J24c-3730	Madsen Machine & Foundry		1950	30	Dug	36	20		unc				I	
496	J24c-3831	Pennsylvania Salt Mfg. Co.			15	Drl	8	200		ws	0.5	7-20-52		U	
497	J24c-3733	Cornwall Chemical Corp.	N. A. Cook	6/47	15	Drl	6	48	32c	ws	8	7-7-47		U	

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Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
498	J24c-3132	Publicker Industries Inc.	Ridpath & Potter	2/45	35	Drl	8	90		ws	6	2-16-45	53		C
499	J24c-3634	Publicker Industries Inc.	Ridpath & Potter	5/43	15	Drl	18-12	36	15s 19c	unc,ws	11	7-8-43			C
500	J24c-3635	Publicker Industries Inc.			15	Drl	17-12			unc,ws	10.6	3-19-54		U	
501	J24c-3533	Publicker Industries Inc.	Ridpath & Potter	12-17-47	15	Drl	6	144	48c	ws	0.9	7-29-53			
502	J24c-3232	Publicker Industries Inc.	Ridpath & Potter		35	Drl	8	72		ws	25	10-2-46	50	I	
503	J24c-3337	Hill Crest Farms Dairy			15	Drl	6	265		ws	14	10-2-46		D	
504	J24c-3337	Hill Crest Farms Dairy			15	Dug	96	20		unc	6	10-2-46	28	X	
505	J24c-3337	Hill Crest Farms Dairy		1943	15	Dug	120	24		unc	6	10-2-46	50	I	
506	J24c-3034	Eppinger & Russell Co.	N. A. Cook	1943	30	Drl	8			ws			22	I	
507	J24c-3034	Eppinger & Russell Co.	N. A. Cook	12/50	30	Drl	6	135		ws			15	I	
508	J24c-3035	Eppinger & Russell Co.			35	Drl	6	35		unc				D	C
509	J24c-3035	E. A. Gerlach Co., Inc.	N. A. Cook		35	Drl		68		ws				I	
510	J24c-2936	Philadelphia Bronze & Brass			30	Drl									
511	J24c-2833	Short Stop Restaurant	L. Carter	5/52	50	Drl	6	64		unc,ws					
512	J24c-2734	Eddington Metal Specialty Co.			50	Dug		30+		unc	20	9/46		I	
513	J24c-2632	Hough Machine Products Inc.	J. D. Hough	1945	60	Drn	2	28		unc				D	
514	J24c-2532	The Jay Co., Inc.		1930	65	Drl	6	65		ws				I	
515	J24c-2434	St. Francis Vocational School	Quinn & Herron	1919	70	Drl	8-6	400		ws			100	U	
516	J24c-2532	St. Francis Vocational School		1930	70	Drl	8	365		ws			40	D	
517	J24c-2433	St. Francis Vocational School	J. O'Donnell & Son		70	Drl				ws				E	
518	J24c-2237	St. Francis Vocational School	R. Hoff	1951	40	Drl				unc,ws				PS	
519	J24c-0549	Lewis Hosiery Co.			35	Dug		30		unc				I	
520	J24c-3255	McKee Estate			15	Drl	6	41		unc				X	
521	J24c-1963	Railway Specialties Corp			25	Dug				unc				U	
522	J24c-1963	Railway Specialties Corp.			25	Drn				unc					
523	J24a-8360	American Industries Co.			75	Dug	36	22		unc,ws					
524	J24a-8360	Mr. Nichols			70	Drl				ws				D	
525	J24b-7704	Bristol Aluminum Co.	N. A. Cook	1947	65	Drl	6			ws			5	D	
526	J24b-7703	Bristol Aluminum Co.	N. A. Cook	8/51	65	Drl	8			ws			50	I	
527	J24d-0105	Rex Engineering, Inc.		1950	30	Dug	36	14		unc				D	
528	J24d-0301	Paul Harrigan & Sons, Inc.			40	Drl		90		ws				I	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
529	J24d-0402	Roadway Excavating Corp.	N. A. Cook		35	Drl				ws				D	
530	J24d-0500	Drum Co.			40	Drl				ws					
531	J24d-1604	Bristol Boro Water Dept.	Artesian Well Drlg.	1942	20	Drl	16-12	70	22s 42c	unc	8	9-11-46	200	PS	P
532	J24d-1501	Bristol Boro Water Dept.	Artesian Well Drlg.	1942	20	Drl	16-12	65	21s 32c	unc	4	9-11-46	220	PS	P
533	J24d-1405	Bristol Boro Water Dept.	Artesian Well Drlg.	1942	20	Drl	16-12	85	20s 40c	unc			480	PS	P
534	J24d-1502	Bristol Boro Water Dept.	Artesian Well Drlg.	1942	20	Drl	16-12	64	28s 29c	unc	4	9-11-46	200	PS	C
535	J24d-1602	Bristol Boro Water Dept.	Artesian Well Drlg.	1943	15	Drl	16-12	54	11s 34c	unc			250	PS	P
536	J24d-1602	Bristol Boro Water Dept.	Artesian Well Drlg.	1953	15	Drl				unc				U	
537	J24d-1503	Bristol Boro Water Dept.	Artesian Well Drlg.	1944	25	Drl	16-12	74	12s 38c	unc	19	9-11-46	200	PS	P
538	J24d-1402	Bristol Boro Water Dept.	Artesian Well Drlg.	1944	25	Drl	16-12	75	12s 36c	unc			150	PS	P
539	J24d-2002	Rohm & Haas Bristol Plant	Layne-New York Co.	8/25	20	Drl	18	85	38.5c	unc	31.3	4-9-46	400	I	
540	J24d-2104	Rohm & Haas Bristol Plant	Layne-New York Co.	10/30	20	Drl	18	98	40s 50.5c	unc	26.5	4-8-46	300	U	
541	J24d-2203	Rohm & Haas Bristol Plant			20	Drl				unc				I	
542	J24d-1902	Rohm & Haas Bristol Plant	Layne-New York Co.	4/34	20	Drl	18	109	70c	unc			290	U	
543	J24d-2203	Rohm & Haas Bristol Plant	Layne-New York Co.	10/39	20	Drl	18	72	37c	unc	25	4-17-46	390	U	
544	J24d-2305	Rohm & Haas Bristol Plant	Layne-New York Co.	12/39	20	Drl	18	72	54.3c	unc	11	4-4-46	950	U	
545	J24d-2305	Rohm & Haas Bristol Plant	Layne-New York Co.	5/41	20	Drl	18	56	36c	unc	11	4-4-46	1,050	U	
546	J24d-2403	Rohm & Haas Bristol Plant	Layne-New York Co.	9/42	15	Drl	16	56	36c	unc	14	4-10-46	775	U	
547	J24d-2304	Rohn & Haas Bristol Plant		8-15-52	20	Drl				unc				I	
548	J24d-2109	Bristol Boro Water Dept.	C. W. Lauman Inc.	9/53	15	Drl	36-20	69.5		unc	11.3	8-8-53		U	
549	J24d-1510	Atlantic Ice Mfg. Co.	T. B. Harper	1910	20	Drl	8	40	30c	unc	13	1910	70	U	
550	J24d-1411	Atlantic Ice Mfg. Co.	T. B. Harper	1910	20	Drl	8	86	60c	unc	18.4	12-14-48		U	
551	J24d-1510	Atlantic Ice Mfg. Co.	Artesian Well Drlg.	1942	20	Drl	12	98	88c	unc	22	12-14-48		U	C
552	J24d-1511	Atlantic Ice Mfg. Co.	N. A. Cook	1949	20	Drl	12	94		unc				I	
553	J24d-1012	Kaiser Metal Products Inc.			25	Dug	96	22		unc	6	9-11-46		U	
554	J24d-1011	Kaiser Metal Products Inc.			25	Dug	96	22		unc	6	9-11-46	500	U	
555	J24d-1517	Manhattan Soap Co. Inc.	Artesian Well Drlg.	1941	25	Drl	12	50	40c	uno	30-35	1946	200	I	
556	J24d-0616	Hunter-Wilson Distilling Co.	Artesian Well Drlg.	1939	30	Drl	16	60	40c	unc	12	9-11-46	200		
557	J24d-0718	Pacific Steel Boiler			25	Dug	72							T	
558	J24d-0619	Penn's Manor Inc.			25	Dug	168	30		unc	18	9-17-46	100	I	
559	J24b-8124	L. D. Davis Co., Edgely Plant	Artesian Well Drlg.	1936	20	Drl	8	45		unc	18	9-5-46	75	I	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
560	J24b-8124	L. D. Davis Co., Edgely Plant	Ridpath & Potter	5/43	20	Drl	8	41	13s 27c	unc	15-18	1946	75	I	
561	J24b-8124	L. D. Davis Co., Edgely Plant			20					unc					
562	J24b-8425	Bristol Boro Water Dept.	Artesian Drlg. Co.	1945	15	Drl	10	50	16c	unc	flowing	2-22-45	300	PS	C
563	J24b-8425	Bristol Boro Water Dept.	Artesian Drlg. Co.	1945	15	Drl	10	50	19c	unc	flowing	2-22-45	400	PS	C
564	J24b-8324	Bristol Boro Water Dept.	Artesian Drlg. Co.	1945	20	Drl	10	50	17c	unc	13.9	9-8-53	250	U	
565	J24b-8325	Bristol Boro Water Dept.	Artesian Drlg. Co.	1945	15	Drl	10			unc				U	
566	J24b-8425	Bristol Boro Water Dept.	Artesian Drlg. Co.	1945	15	Drl	10	17.5		unc	3.2	8-7-53		U	
567	J24b-8128	Paterson Parchment Paper Co.	Layne-New York Co.	6/34	15	Drl	8-6	78		unc	18	6-5-35		T	
568	J24b-8129	Paterson Parchment Paper Co.	Layne-New York Co.	6/34	15	Drl	8-6	115		unc	21	6-14-34		T	
569	J24b-8227	Paterson Parchment Paper Co.	Layne-New York Co.	6/34	15	Drl	8-6	83		unc	4	6-19-34		T	
570	J24b-8227	Paterson Parchment Paper Co.	Layne-New York Co.	6/34	15	Drl	8-6	82		unc	9	6-26-34		T	
571	J24b-8028	Paterson Parchment Paper Co.	Layne-New York Co.	7/34	15	Drl	8-6	92		unc	4	7-3-34		T	
572	J24b-8327	Paterson Parchment Paper Co.	Layne-New York Co.	1934	15	Drl	44-26	33	10s 23c	unc	16	9-18-46	300	I	
573	J24a-5248	Wood School	J. H. Rulon	1934	160	Drl	10-8	318		gn			200		
574	J24a-4947	Wood School	N. A. Cook	1948	200	Drl				gn					
575	J24a-5344	Wood School	N. A. Cook	1948	210	Drl				gn					
576	J24a-5346	Wood School	N. A. Cook	1948	200	Drl				gn					
577	J24a-5243	Wood School	N. A. Cook	1949	210	Drl				gn					
578	J24a-4863	Skyway Grill	N. A. Cook		150	Drl				Cch					
579	J24a-4864	Airport Service Station	N. A. Cook		150	Drl				Cch					
580	J24a-4863	Newtown Ford Inc.	N. A. Cook		155	Drl				Cch					
581	J24a-4863	Newtown Ford, Inc.	N. A. Cook		150	Drl				Cch					
582	J24c-0851	Falls Twp Water & Sewer Auth.	N. A. Cook	1953	20	Drl				ws					
583	J24c-2154	U.S. Concrete Pipe Co.	J. Rulon	2/51	25	Drl	6	180	88c	ws	8	2-20-51	18	I	
584	J24b-6309	Hunter Mfg. Corp.	Artesian Drlg. Co.	1942	110	Drl	8	157	32c	ws	40	9-5-46	120	U	
585	J24b-6309	Hunter Mfg. Corp.		1946	105	Drl	4	159		ws			200	I	C
586	J24b-6015	Bell Telephone Co. of Pa.	Ridpath & Potter	2/52	100	Drl	6	97	30c	ws			20		
587	J24b-5231	Sand & Gravel Co.	N. A. Cook		40	Drl				unc					
588	J24b-7234	Silvi Concrete Products	N. A. Cook	1946	30	Drl	6	135		gn				I	
589	J24b-8130	Lower Bucks Co. Municipal Auth.	C. W. Lauman & Co.	8/51	8	Drl	12	27	10.7s 26.3c	unc	9.6	12-19-51		T	
590	J24b-8130	Lower Bucks Co. Municipal Auth.	C. W. Lauman & Co.	1951	13	Drl	2	250		unc				T	
591	J24b-8130	Lower Bucks Co. Municipal Auth.	C. W. Lauman & Co.	1/52	8	Drl	20	34.8	11.3s 25.2c	unc				PS	

Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of Measurement	Yield (gpm)	Use	Chem Anal
592	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1/52	9	Drl	20	34.4	11.3s 24c	unc				PS	
593	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	2/52	10	Drl	20	36.9	11.3s 27.2c	unc				PS	
594	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	2/52	12	Drl	20	39.7	11.3s 29.9c	unc				PS	
595	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	3/52	11	Drl	20	36	11.3s 26.8c	unc			725	PS	C
596	J24b-8130	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1953	15	Drl				unc				PS	
597	J24b-8130	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	9	Drl	6			unc				T	
598	J24b-8130	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	8	Drl	6			unc				T	
599	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	13	Drl	2	24.5		unc				T	
600	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	11	Drl	2	29		unc				T	
601	J24b-8229	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	8	Drl	2	20.3		unc				T	
602	J24b-8230	Lower Bucks Co. Municipal Auth.	C. Lauman & Co.	1952	7	Drl	2	21.3		unc				T	
603	J24b-7331	Levitt & Co.			25	Drl				unc				I	
604	J24b-7330	Levitt & Co.			25	Drl				unc				I	
605	J24b-7231	Levitt & Co.			25	Drl				unc				I	
606	J24b-4904	Falls Twp. Water & Sewer Auth.	N. A. Cook	1951	140		6	75		ws			45	PS	
607	J24b-4804	Falls Twp. Water & Sewer Auth.	N. A. Cook	1951	145	Drl	8	302		ws			35	PS	
608	J24b-4805	Falls Twp. Water & Sewer Auth.	N. A. Cook	1951	145	Drl	8	113		ws			40	PS	
609	J24b-4317	Falls Twp. Water & Sewer Auth.	N. A. Cook		125	Drl				ws				PS	
610	J24b-4417	Falls Twp. Water & Sewer Auth.	N. A. Cook		125	Drl				ws			15	PS	C
611	J24b-4617	Falls Twp. Water & Sewer Auth.	N. A. Cook		105	Drl				ws				PS	
612	J24b-4618	Falls Twp. Water & Sewer Auth.	N. A. Cook		105	Drl				ws			25	PS	C
613	J24b-4129	Fallingston Mfg. Co.		1949	85	Drl	4	80						D	
614	J24b-4939	Amico Sand & Gravel Co.	N. A. Cook	1948	40	Drl	6	69		unc				D	
615	J24b-4844	Pennsbury Pottery		1950	45	Drl	4	60		unc				I	
616	J24b-4043	Falls Twp. Water & Sewer Auth.	N. A. Cook	1952	45	Drl	6	102		unc	6.5	10-27-52		T	
617	J24b-4143	Falls Twp. Water & Sewer Auth.	N. A. Cook	1952	45	Drl	8	83		unc	9.6	10-27-52		T	
618	J24b-4143	Falls Twp. Water & Sewer Auth.	N. A. Cook	1952	45	Drl	6	100		unc				T	
619	J24b-4142	Falls Twp. Water & Sewer Auth.	N. A. Cook	1952	45	Drl	6	100		unc				T	
620	J24b-4143	Falls Twp. Water & Sewer Auth.	N. A. Cook	1953	45	Drl				unc			700	PS	
621	J24b-3147	Bucks Co. Farms Dairies		1930	55	Drl	6	80		gn			10	I	C
622	J24b-3147	Bucks Co. Farms Dairies		1944	55	Drl	6	160		gn			16	I	

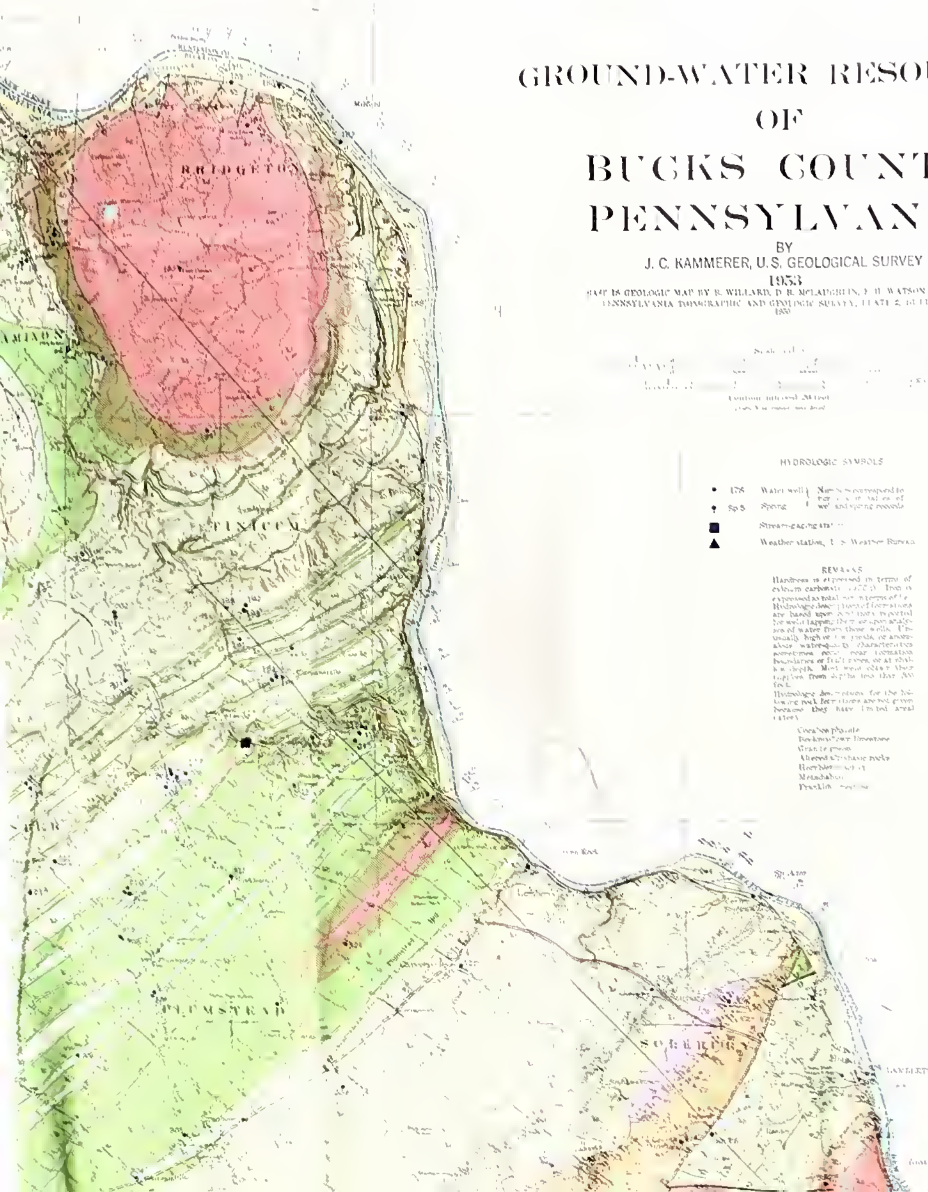
Well No. Bk-	Location No.	Owner	Driller	Date completed	Altitude (feet)	Type of Well	Diameter (in.)	Depth (feet)	Depth of casing and/or screen (feet)	Aquifer	Water Level (feet)	Date of measurement	Yield (gpm)	Use	Chem Anal
623	J24b-2951	Consumers Ice Co.		1915	40	Drl	6	30		unc			25	U	
624	J24b-2952	Vulcanized Rubber & Plastics Co.	T. Harper	1903	30		8	716	35c	gn	18	1946		U	
625	J24b-3354	Morrisville Boro Water Dept.	Layne-New York Co.	10/35	20	Drl	8	74		unc	27	10-10-35		T	
626	J24b-3656	Morrisville Boro Water Dept.	Layne-New York Co.	1/37	21	Drl	8	146.5		unc	11	1-7-37	280	T	
627	J24b-3957	Morrisville Boro Water Dept.	Layne-New York Co.	2/37	21	Drl	10-8-6	117		unc	19	2-27-37		T	
628	J24b-3957	Morrisville Boro Water Dept.	Layne-New York Co.	6/51	25	Drl	24-16-10	175	165s 139c	unc	16.7	8-5-53	700	U	
629	J24b-4060	Victor Chemical Works	Layne-New York Co.	1948	18	Drl	16-10	175		unc	10	3-31-48	100	I	C
630	J24b-3950	King Supply Co.	Ridpath & Potter	8/51	25		6	40	30c	unc	16	1951			
631	J24b-4149	Cartex Corp.			25		6			unc				I	
632	J24b-5544	Warner Co. Van Sciver Plant	Philadelphia Drlg.	2/51	25		6	31	24.5c	unc	6	2/51	10	I	
633	J24b-6751	King Farms Co.	Artesian Drlg. Co.	1929	20	Drl	12	70	70c	unc	6.2	5-25-50		U	
634	J24b-6751	King Farms Co.	W. Stothoff	1944	21	Drl	12	58	10s 48c	unc			300	I	C
635	J24b-7146	King Farms Co.	W. Stothoff	1944	20	Drl	12	55	13s 42c	unc	13.2	5-25-50		D	
636	J24b-6750	King Farms Co.	Ridpath & Potter	1/50	20	Drl	12	68	58s 13c	unc	15	1/50	170	I	C
637	J24b-6058	U. S. Steel, Fairless Works	Bainbridge Bros.	4/47	20	Drl	8	25	10s 15c	unc	10	4/47		I	
638	J24b-8056	Pennsbury Manor			15	Drl	6			unc	8.9	6-13-50	50	D,Irr	C
639	J24b-6865	U. S. Steel, Fairless Works			25	Dug				unc				D	C
640	J24b-7863	U. S. Steel, Fairless Works			15	Dug				unc				D	C
641	J25a-7603	U. S. Steel, Fairless Works			15	Dug				unc				D	C
642	J25a-7304	U. S. Steel, Fairless Works			15	Dug				unc				D	C
643	J25a-6907	U. S. Steel, Fairless Works			15	Dug				unc				D	C
644	J25a-6313	U. S. Steel, Fairless Works			15	Dug				unc				D	C
645	J25a-6704	U. S. Steel, Fairless Works		1926	20	Drl	8	40		unc			600	I	C
646	J25a-6706	U. S. Steel, Fairless Works		1942	15	Drl	8	30		unc	23	1946		I	
647	J25a-5506	U. S. Steel, Fairless Works		1944	15	Drl	6-4.5	50.5		unc	14.9	9-21-48	60	U	
648	J24b-5962	U. S. Steel, Fairless Works		1950	20	Drl	4	62.0	65c	unc	18.6	3-15-51		T	
649	J24b-5565	U. S. Steel, Fairless Works		1951	25.5	Drl	12	33		unc	22	7-17-53		T	
650	J25a-5710	U. S. Steel, Fairless Works	Ranney Water Inc.		13		12	42		unc	23.7	7-17-53		T,U	
651	J25a-5610	U. S. Steel, Fairless Works	Ranney Water Inc.	1952	7			50		unc				I	
652	J25a-6213	U. S. Steel, Fairless Works	Ranney Water Inc.	1952	15			60		unc				I	

Addendum to Bulletin W-11
Pennsylvania Geological Survey, 4th series, 1955

Sheet 22

Well no. Bk-	Location no.	Owner	Driller	Date com-pleted	Alti-tude (feet)	Type of well	Diam-eter (in.)	Depth (feet)	Depth of casing end/ or screen (feet)	Aquifer	Water level (feet)	Date of measure-ment	Yield (gpm)	Use	Chem. anal.
653	J25a-6513	U. S. Steel, Fairless Works	Ranney Water Inc.	1952	4			36		unc				I	
654	J24b-4660	Philadelphia Electric Co.	Artesian Drlg. Co.	1951	20	Drl	6	70	6s 60c	unc	15	9/51		I	
655	H24c-7556	DollingtonSchool			250					Trl					
656	H24c-6544	Schalck Brothers			235					Trb					
657	H24c-6943	Rohm and Haas Co			225					Trb					
658	H24c-7043	Rohm and Haas Co.			225					Trb					
659	H24c-7043	Rohm and Haas Co.			240	Drl		114		Trb					
660	H24c-7046	Rohm and Haas Co.			210					Trb					
661	J24a-2534	George School			160		10	205		Trs					
662	J24a-2834	George School			140					Trs					
663	H24c-7753	George K. Balderston	John Rulon	1930	270		4	150		Trl	16	4/53	12	D	C
664	H23d-3534	General Greene Inn	John Wiley	1910	235	Drl	6	90		Cc			5		C

22
22 23
G
H
GRO
SPRINGFIELD
DURHAM
BRIDGETON
NOCKAMIXON
HAYCOCK
TINICUM
RICHLAND
QUAKERTOWN
MILFORD
BEDMINSTER
EAST ROCKHILL
WEST ROCKHILL
PLUMSTEAD
NORTHAMPTON CO
BUCKS CO



GROUND-WATER RESOURCES OF BUCKS COUNTY PENNSYLVANIA

BY
J. C. KAMMERER, U.S. GEOLOGICAL SURVEY
1953

HYDROLOGIC SYMBOLS

Water well

Spring

Weather station, U. S. Weather Bureau

REMARKS

Brunswick lithofacies

Lockatong lithofacies

Stockton lithofacies

Hardyston and Chickies quartzite

Wissahickon schist

Gneiss

ABBREVIATIONS

STRUCTURE SYMBOLS

Fault

Concealed fault

Thrust fault

Strike and dip of beds

Horizontal bed

Fossil locality

EXPLANATION

ROCKS

QUATERNARY

TRIASSIC

Lockatong lithofacies

Stockton lithofacies

ORDOVICIAN

Cambrian limestones

CAMBRIAN

Hardyston and Chickies quartzite

Granite gneiss

Altered ultrabasic rocks

Hornblende schist

PRE-CAMBRIAN OR EARLY PALEOZOIC

G
H

H
J

SOURCE ... GRAPHIC AND CULTURAL DATA

U. S. Army Map ... Quadrangles – 7½ minute series

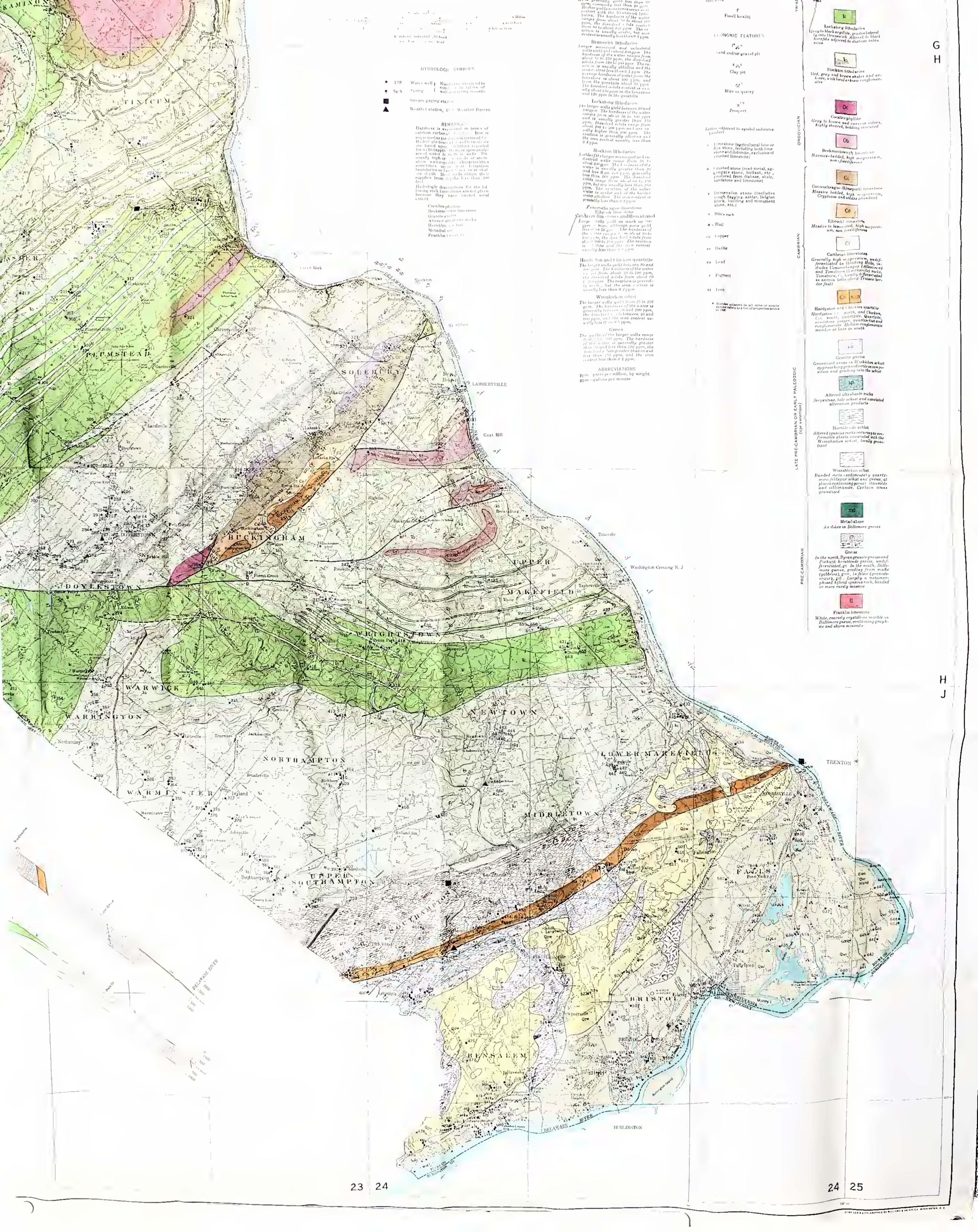
Bedminster
Beverly
Buckingham
Bristol
Columbus

Sherman
Telford
Trenton East
Trenton West

U. S. ... Survey Quadrangles – 15 minute series

Pennsylvania Department of Highways

... Highway Map ... unpublished



HYDROLOGIC SYMBOLS
ECONOMIC FEATURES
REMARKS
ABBREVIATIONS
ppm—parts per million, by weight
gpm—gallons per minute
TRIAS
Lockatong lithofacies
Stockton lithofacies
Red, gray and brown shales and arkoses, with local arkose conglomerates
ORDOVICIAN
Cocalico phyllite
Gray to brown and various colors, highly sheared, bedding obscured
Beekmantown limestone
CAMBRIAN
Conococheague (Limeport) limestone
Elbrook limestone
Cambrian limestones
Hardyston and Chickies quartzite
LATE PRE-CAMBRIAN OR EARLY PALEOZOIC (age uncertain)
Granite gneiss
Altered ultrabasic rocks
Serpentine, talc schist and associated alteration products
Hornblende schist
Wissahickon schist
PRE-CAMBRIAN
Metadiabase
As dikes in Baltimore gneiss
Gneiss
Franklin limestone
White, coarsely crystalline marble in Baltimore gneiss, containing graphite and skarn minerals
TINICUM
PLUMSTEAD
SOLEBURY
BUCKINGHAM
DOYLESTOWN
UPPER MAKEFIELD
WRIGHTSTOWN
WARWICK
WARRINGTON
NEWTOWN
NORTHAMPTON
LOWER MAKEFIELD
WARMINSTER
MIDDLETOWN
UPPER SOUTHAMPTON
FALLS
BRISTOL
BENSALEM
LAMBERTVILLE
TRENTON
BURLINGTON
DELAWARE RIVER
Washington Crossing N. J.
G
H
J
23
24
25